POLITECNICO DI TORINO

Master's Degree in Aerospace Engineering

Master's Degree Thesis

A comprehensive analysis of Aviation Safety Reports in Europe

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Abstract

The European Safety Regulation framework is shaped by a variety of laws and regulations with different scopes, on an international, a European, and a national level. Every year each member state of the EU must publish a full Annual Safety Review, according to Regulation (EU) No 376/2014 of the European Parliament and of the Council that came into force in 2015. This thesis presents a comparative analysis of the Annual Safety Review published by a selected list of 19 European countries. The selection criteria have been chosen in order to guarantee a diverse geographical and cultural background for this study. The analysis covers the years 2015 - 2020, and contains:

1) a brief commentary on each national Review and a classification based upon the number of published relevant documents in the time-span of interest;

2) an in-depth analysis of each Safety Review published 2019 - the most recent year with an high number of published documents - that shows the main divergences and similarities between the cases;

3) a guideline for the publication of the Safety Reviews, with a template for such documents based on a proposal for a set of common criteria, which have been designed to facilitate the exchange of information and data comparison between different countries, and to improve the accessibility of the reports for non-expert users.

Abstract

Il quadro normativo europeo sulla sicurezza è formato da una varietà di leggi e regolamenti con diversi obiettivi, a livello internazionale, europeo e nazionale. Ogni anno ciascuno Stato membro dell'UE deve pubblicare un rapporto annuale sulla sicurezza completo, secondo il regolamento (UE) n. 376/2014 del Parlamento europeo e del Consiglio, entrato in vigore nel 2015. Questa tesi presenta un'analisi comparativa dell'Annual Safety Review pubblicato da un elenco selezionato di 19 paesi europei. I criteri di selezione sono stati scelti al fine di garantire un background geografico e culturale diversificato per questo studio. L'analisi copre gli anni 2015 - 2020, e contiene:

1) un breve commento su ogni Review nazionale e una classificazione basata sul numero dei relativi documenti pubblicati nell'arco di tempo di interesse;

2) un'analisi approfondita di ogni Safety Review pubblicato nel 2019 - l'anno più recente con un alto numero di documenti pubblicati - che mostra le principali divergenze e somiglianze tra i casi;

3) una linea guida per la pubblicazione delle Safety Review, con un modello per tali documenti basato su una proposta di una serie di criteri comuni, che sono stati progettati per facilitare lo scambio di informazioni e il confronto dei dati tra diversi paesi, e per migliorare l'accessibilità dei reports per gli utenti non esperti.

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Acronyms

ABL
AnalyseBureau Luchtvaartvoorvallen

ADREP
Accident/incident Data REPorting

AESA
Agencia Estatal de Seguridad Aérea

AI
Airspace Infringements

AIB
Accident Investigation Bureau

ALoSP
Acceptable Level of Safety Performance

AMC
Acceptable Means of Compliance

ANAC
Autoridade Nacional da Aviação Civil

ANC
Air Navigation Commission

ANSP
Air Navigation Service Providers

AOC
Air Operators Certificate

ARC

Abnormal Runway Contact

ARMS

Airline Risk Management Solutions

ASR

Annual Safety Review

ATC

Air Traffic Control

ATM

Air Traffic Management

BEA

Bureau of Enquiry and Analysis for civil aviation safety

CA

Commercial Aviation

CAA

Civil Aeronautical Authority

CAT

Commercial Air Transport

CEANITA

Comisión de Estudio y Análisis de Notificaciones de Incidentes de Tránsito Aéreo

CFIT

Controlled Flight Into or towards Terrain

CS

Certification Specifications

DGAC

Direction Généralede l'Aviation Civile

EASA

European Union Aviation Safety Agency

EASP

European Aviation Safety Programme

EC's

European Commission's

ECCAIRS

End-User and Technical Courses on the European Coordination Centre for Accident and Incident Reporting Systems

ECR

European Central Repository

eE-MOR

electronic ENAC Mandatory Occurrence Reporting

ENAC

Ente Nazionale per l'Aviazione Civile

EPAS

European Plan for Aviation Safety

EU

European Union

EVTs

Evaluation Tasks

FAA

Federal Aviation Administration

FOCA

Federal Office of Civil Aviation

F-POST

POST-impact Fire/smoke

GA

General Aviation

GASP

Global Aviation Safety Plan

GCOL

Ground Collisions

GM

Guidance Material

IAA

Irish Aviation Authority

IATA

International Air Transport Association

ICAO

International Civil Aviation Organization

ILT

Inspectie Leefomgeving en Transport

IR

Implementing Rules

ISMS

Integral Safety Management System

ISSG

Industry Safety Strategy Group

JRC

Joint Research Centre

LALT

Low Altitude Flight

LB

Level Busts

LOC-G

Loss of Ground Control

LOC-I

Loss of Control In-air

LVNL

Luchtverkeersleiding Nederland

MAC

Mid-Air Collision

MSTs

Member State Tasks

RASO

Relatório Anual de Segurança Operacional

RASP

Regional Aviation Safety Plan

RE

Runway Excursions

RES

Research Actions

RI

Runway Incursions

RMTs

Rulemaking Tasks

SEIs

Safety Enhancement Initiatives

SES

Single European Sky ATM Master Plan

SMI

Separation Minima Infringements

SMS

Safety Management System

SPAS

State Plans for Aviation Safety

SPI

Safety Performance Indicators

SPTs

Safety Promotion Tasks

SRM

Safety Risk Management

SSP

State Safety Program

TKA

Transporto Kompetencijų Agentūrą

ULC

Urząd Lotnictwa Cywilnego

Chapter 1

Introduction

Before beginning the study and analysis of the documents of interest for this thesis, it is necessary to make an introduction to the legislative environment. The institutions and instruments that are used are different depending on the point of view. This chapter explains which institutions are responsible for the regularisation of legislation at international, European and national level, the respective instruments used by each of them and the reasons for their adoption.

1.1 International regulatory framework

The importance of the concept of safety has become more and more evident during the last few decades, and it has been studied in many different fields. In particular, it is the International Civil Aviation Organization (ICAO) - the highest competent institution in the world on this subject – to offer a first definition in the Safety Management Manual Doc 9859, [1]:

"Safety is the state in which the possibility of harm to persons or property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and risk management."

In 1997 the Global Aviation Safety Plan (GASP) was introduced: it formalizes a series of conclusions and directions which have been developed during an informal meeting between the ANC (Air Navigation Commission) and industry. Safety then began to acquire a central relevance in the Aviation scenario. The aim of this document is to set targets, which are in accordance with the Safety Enhancement Initiatives (SEIs), and through them improve safety at international, regional and national levels.

ICAO and the aviation industry expressed the need to expand the role of GASP, making it a common reference framework for all the stakeholders, which would be able to offer a more proactive approach to aviation safety in contributing to a better coordination of safety policies and initiatives worldwide, with the aim of reducing the risk of accidents in commercial aviation. To achieve this purpose the Industry Safety Strategy Group (ISSG) was introduced and it developed the global aviation safety roadmap that was the main basis for the 2007 edition of GASP.

1.2 Europe regulatory framework

At a legislative level, there is a delicate issue: ICAO can only make standards, i.e. actions whose application is recommended to Member States, but which are not mandatory. In order for them to become such, the creation of a law is necessary. The European Union Aviation Safety Agency (EASA) is in charge of this task in Europe, developing a regional safety management plan for its Member States, establishing a guideline and outlining the main risks affecting the European aviation system and the actions needed to mitigate them and further improve aviation safety. This plan is the European Plan for Aviation Safety (EPAS), which runs for five years but it is reviewed and updated annually. It is not only implemented by EASA, but it is the result of a close collaboration between its Member States and industry. The main objective of EPAS is to further improve aviation safety and environmental protection across Europe, while ensuring a level playing field and efficiency/proportionality in the regulatory processes. It aspires to achieve a steady improvement in safety within an ever-growing aviation industry in the future.
The latest version of this document contains a total of 180 actions and guidelines covering the improvement of aviation safety and the relationship between efficiency and proportionality in regulatory processes. These can be divided into five different categories:

- RuleMaking Tasks (RMTs), which include new or amended regulatory material, for example: Implementing Rules (IR), Acceptable Means of Compliance (AMC), Certification Specifications (CS), or Guidance Material (GM);

- Safety Promotion Tasks (SPTs), which regard both safety training and all awareness and education activities, as well as dissemination of information that useful to involve and interact with stakeholders, whether private or public;

- RESearch actions (RES), which are research projects related to the innovation and efficiency of the introduction of new technologies or concepts in order to guarantee a measure of improvement of the environmental performance of the aeronautical sector;

- EValuation Tasks (EVTs), which are tasks used to assess whether existing regulations or initiatives are delivering the expected results at minimum cost;
- Member State Tasks (MSTs), which concern the member states and must be taken into account for the development of the State Plans for Aviation Safety (SPAS).

Most of the 180 actions are attributed to the category of RMTs (about 60 %), followed by SPTs (about 15 %) and RES (about 12 %).
In addition to being divided into categories, the actions within EPAS can be divided into twelve different areas of interest:

1. Systemic safety;
2. Competence of personnel;
3. Flight operations - aeroplane;
4. Rotorcraft;
5. General Aviation;
6. Design and production;
7. Maintenance and continuing airworthiness management;
8. Air traffic management / Air navigation services;
9. Aerodromes & Groundhandling;
10. Unmanned aircraft systems;
11. New technologies and concepts;
12. Environmental protection.

More than half of the actions in EPAS refer to either Systemic Safety or Competence of Personnel.
Systemic Safety studies the risk management of a programme and the application of engineering principles and techniques. Its aim is to optimise safety management by identifying risks, eliminating or controlling them, and designing processes or procedures so that they are below a set value. Thanks to the adoption and continuous development of this concept and similar techniques, safety has improved steadily and continuously in every area of operation in recent years, although recent accidents and serious incidents show how complex and important the study of safety is.

Since complexity and technological advancement are often not conducive to increasing safety, authorities and organisations in the aviation world shall anticipate new emerging threats by developing new Safety Risk Management (SRM) techniques and principles. This can be satisfied by implementing the Safety Management System (SMS) supported by ICAO Annex 19, [2], and EU Regulation 376/2014, [3], on occurrence reporting, analysis and follow-up in civil aviation.
The ninth version of EPAS, the five-year period 2020 - 2024, is currently in force. The following key actions regarding Systemic Safety can be found:

- support the realisation of a robust surveillance system across Europe;
- combine safety management requirements with initial and continued airworthiness concepts;
- support states in the implementation of state safety programmes and plans;
- encourage international harmonisation of the implementation of SMS and human factors principles.

Furthermore, the EPAS has been drafted following the guidelines offered by ICAO with the GASP, ensuring alignment with the Single European Sky (SES) ATM Master Plan, and in accordance with the European Commission's (EC's) and the European Aviation Safety Programme (EASP).

1.3 National regulatory framework

ICAO Annex 19, [2], demands that all Member States implement a State Safety Program (SSP) while providers are required to establish an SMS. At this point, the focus of the regulatory framework is on a national, and no longer international, level.
According to the ICAO SSP framework, an SSP is based on three principal elements:

- strategy: a set of targets established by the competent authority;
- programme: a series of activities and regulations designed to improve safety;
- plan: all actions developed to achieve the set safety targets;

Once the requirements of ICAO Annex 19 have been defined, it is useful to refer to the other fundamental document that regulates the European regulatory framework of the various nations: Regulation (EU) No 376/2014 of the European Parliament and of the Council, [3], published on 3 April 2014. This Regulation concerns the reporting, analysis and monitoring of occurrences in civil aviation, modifying the following documents:

– Regulation (EU) No 996/2010 of the European Parliament and of the Council;

– Directives 2003/42/EC of the European Parliament and of the Council;

– Commission Regulations (EC) No 1321/2007;

– Commission Regulations (EC) No 1330/2007.

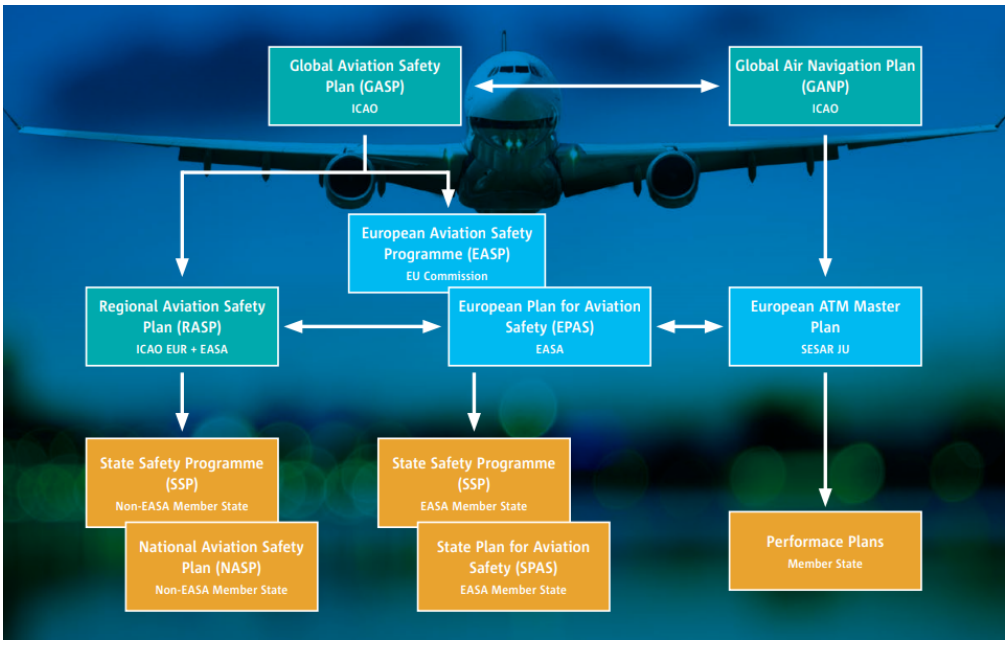

Figure 1.1: Relationship between GASP and EPAS and other programmes and plans, [4]

Within the text it is of fundamental importance to highlight two articles related to the purpose of this study, paragraphs three and four of the seventh article and paragraph eleven of the thirteenth.
The interesting part of the seventh article is quoted below:

"Article 7: Quality and content of occurrence reports
(3.) Organisations, Member States and the Agency shall establish data quality checking processes to improve data consistency, notably between the information collected initially and the report stored in the database.
(4.) The databases (. . .) shall use formats which are:
- standardised to facilitate information exchange;
- and compatible with the ECCAIRS software and the ADREP taxonomy."

From this it can be seen that Member States, organisations and agencies are called upon to carry out quality data collection in order to ensure consistency

between the new data collected and the data already present in the database.
Another crucial factor is the aspect of standardisation, as Member States are required to facilitate the exchange of information and use formats that are compatible with the ECCAIRS (End-User and Technical Courses on the European Coordination Centre for Accident and Incident Reporting Systems) software and the ADREP taxonomy.ECCAIRS is a software suite that is still under constant development and distributed by JRC (Joint Research Centre) to the CAA (Civil Aviation Authorities) and AIB (Accident Investigation Bureaus) of the EU Member States that are authorised to use the software for the implementation of Directive 2003/42/EC on Occurrence Reporting in Civil Aviation.

The eleventh paragraph of Article 13 reads as follows:

"Article 13: Occurrence analysis and follow-up at national level
(11.) In order to inform the public of the level of safety in civil aviation, each Member State shall publish a safety review at least once a year. The safety review shall:
- contain aggregated and anonymised information on the type of occurrences and safety-related information reported through its national mandatory and voluntary reporting systems;
- identify trends;
- identify the action it has taken."

Every EASA and EU Member States shall publish an annual report that satisfies all requirements.
It should be noted that countries are subject to the duty to publish an annual report, not necessarily for the current year. Penalties are foreseen as sanctions for violations of this regulation and they are set by the Member States themselves. The provided sanctions are not intended to be punitive, but they must be effective, proportionate and dissuasive.
The previously mentioned Regulation (EU) 376/2014, [3], not only sets out the obligations of the Member States, but also clarifies some doubts by offering a sort of guideline on which events must be reported and illustrating a first sort of standardisation. The events that are under a mandatory reporting are listed in Article 4 and also divided into categories of activities:

1. occurrences related to the operation of the aircraft;
2. occurrences related to technical conditions, maintenance and repair of aircraft;
3. occurrences related to air navigation services and facilities;
4. occurrences related to aerodromes and ground services.

The Regulation 376/2014 also highlights all those persons who have to report, in particular they are obligated to communicate the events and the corresponding details to the competent authority of the Member State as soon as possible and, in any case, no later than 72 hours after becoming aware of it.
In conclusion, an example can be made taking into consideration the case of Italy. The Italian State Safety Program, [5], follows the indications of ICAO Annex 19 and the Safety Management Manual, providing the definition of indicators to measure the level of safety performance achieved in Italian civil aviation. These indicators, called SPI (Safety Performance Indicators), have the objective of verifying the achievement and maintenance of a target defined on a State level by the SSP, called ALoSP (Acceptable Level of Safety Performance). The safety plan defined by ENAC, the competent authority on a National level, complies with the guidelines of the European plan and has a five-year duration: the latest edition concerns 2021-2025, [6].
Furthermore, ENAC must comply with the obligation to carry out a collection of State safety data, as well as their analysis, sharing them and publishing an ASR (Annual Safety Review) in order to inform the public and to comply with Regulation (EU) 376/2014. The latest Italian report is the one of the year 2021 present inside the national safety portal, [7]. The data contained in this document are those available in the ENAC eE-MOR (electronic ENAC Mandatory Occurrence Reporting) system for the four-year period 2015-2019, with reference to the SPI established in the same document.

Chapter 2

Safety Review analysis at European level

After defining the regulatory framework and all the rules as well as the documents that the concerned states are required to respect and follow, one might think to find an ideal situation in which all the states publish their Safety Reviews following a common strategy, making their civil aviation data visible and easily available to their citizens, but this is not exactly the scenario.
This chapter will analyse the general overview of a selection of countries that are members of both EASA and the European Union, in addition to two other external elements taken as a comparison: the United Kingdom, subject to these rules until Brexit at the beginning of 2020, and Brazil, a country closer to the Federal Aviation Administration (FAA) from a legislative point of view.

2.1 General overview

A time period from 2013 to 2020 is analysed, although the mandatory publication has been in place since 2015, it can be seen that many countries had already adopted a first draft Safety Review even before the introduction of the publication obligation. This first draft is considered during the analysis of the general framework as complying with the publication of a Safety Review, even though such documents did not always meet the guidelines introduced by Regulation 376/2014 of the European Council, [3]. The respective countries made small changes in order to meet the requirements from 2015.
The table below shows all publicly available Safety Reviews for 18 of the 31 states that met the requirements outlined above. For EASA member states, reference is made taking into account the list on the organisation's official website, [8]. The same is done for European Union (EU) members, all information can be found on

the organisation's official portal, [9].
The problems faced are diverse, as are the differences between the Safety Review of one country and another. After the table there is a brief summary of the situation in each country with a commentary, highlighting both the strengths and difficulties encountered.

	2013	2014	2015	2016	2017	2018	2019	2020
Austria					x			
Belgium						x		x
Finland							x	x
France	x	x	x	x	x	x	x	x
Hungary								
Ireland	x	x	x	x	x	x	x	x
Italy				x			x	x
Latvia	x	x	x	x	x	x	x	x
Lithuania								x
Malta								x
Netherlands					x	x	x	x
Norway							x	
Poland					x	x		
Portugal		x	x					
Romania		x	x	x		*	*	*
Slovakia				x	x	x	x	
Spain	x	x	x	x	x			
Sweden	x	x	x	x	x	x	x	x
Swiss					x	x	x	x
Brazil	x	x	x	x	x	x	x	
United Kingdom	x	x	x	x	x	x	x	

Table 2.1: Overview of Safety Review documents published by EASA and EU Member States plus UK and Brazil ("x" represents documents while "*" indicates special cases which will be explained below).

It can be seen that only 7 countries out of 19 (36.84%) published at least 4 Safety Reviews in a 6-year period (2015 - 2020): two publications less than the annual one required by the legislation. Looking at individual cases, the graph below shows the breakdown of countries by SR published, from the case of 0 to the best case of 6 publications in the 6 years covered by the analysis.

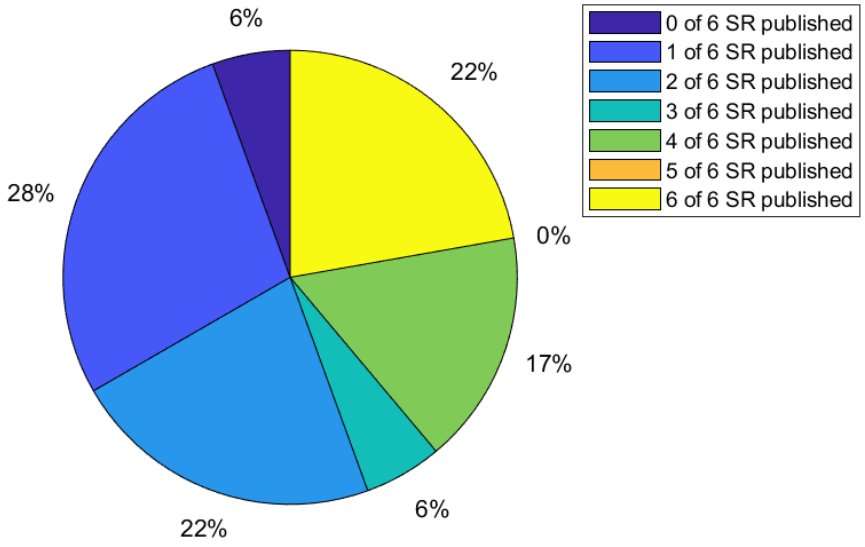

Figure 2.1: Distribution of countries according to Safety Reviews published in the considered period (2015-2020).

It is important to point out that the publication of a Safety Review is not directly linked to a good country's safety culture, the opposite is also true. There are many reasons for this, the main one is the fact that there is no temporary obligation for a Safety Review to be kept public. An organisation can publish a document and the following year replace it with an updated version (from the table above, this could be the cases of Norway and Malta, both have only one SR published but at a recent date).
It is necessary to check which years the public data refer to for each state to provide a more equal view of the scenario, in order to highlight how eradicated or not safety culture is within that nation. For this purpose the following table is created. The circles represent the data available for that year in the documents published by each country.

	2013	2014	2015	2016	2017	2018	2019	2020
Austria	o	o	o	o	o			
Belgium		o	o	o	o	o	o	o
Finland							o	o
France	o	o	o	o	o	o	o	o
Hungary								
Ireland	o	o	o	o	o	o	o	o
Italy		o	o	o	o	o	o	o
Latvia	o	o	o	o	o	o	o	o
Lithuania					o	o	o	o
Malta					o	o	o	o
Netherlands					o	o	o	o
Norway							o	
Poland	o	o	o	o	o	o		
Portugal	o							
Romania		o	o	o		o	o	o
Slovakia				o	o	o	o	
Spain	o	o	o	o	o			
Sweden	o	o	o	o	o	o	o	o
Swiss				o	o	o	o	o
Brazil	o	o	o	o	o	o	o	
United Kingdom	o	o	o	o	o	o	o	

Table 2.2: Overview of public safety data available for EASA and EU Member States plus UK and Brazil ("o" indicates publicly available data within a released document).

2.1.1 France, Ireland, Latvia and Sweden

At the time of this study, there were no countries with five Safety Reviews published. However, four countries have respected the annual frequency of publication required by the legislation - six for the six years under review: France, Ireland, Latvia and Sweden.

The French Safety Review is produced by the Ministry that regulates national transport (Ministère Chargé Des Transports). The website of this ministerial department is only available in French, and all the reports are written exclusively in the local language, so the accessibility is restricted to those who know it, although the document can easily be translated with the help of an external translator. The SRs present in the French authority's website are for the years: 2015, [10], 2016, [11], 2017, [12], 2018, [13], 2019, [14], and 2020, [15]. One factor to highlight in these

documents is the form with witch data are represented, since during the analysis of occurrences according to the SPIs - which are also translated into French so that it is not always easy to link them to the corresponding meaning according to the regulations - they are expressed as a percentage of the total number of accidents, divided into fatal and non-fatal. In addition, the data are cumulative - for example in the last published document, the one for 2020 - the present data are respective of the period from 2011 to 2020, although there is a summary graph comparing the trend of the indices taken into consideration in the period 2011-2020 with those of the last year, in this case 2020. It should also be pointed out that the French authority carries out a double statistical study. In fact, there is a first study relating to aircraft registered in France and a second one exclusively for aircraft registered in foreign countries but for which the occurrence is handled by the French authorities: a factor that is not normally taken into account within the Safety Reviews of other countries.

In Ireland, it is the Irish Aviation Authority (IAA) who is responsible for the publication of the Safety Reviews. Being an exclusive authority for the aviation sector, it is easy to find the page dedicated to the publication of SRs. Inside the main menu there is a section exclusively dedicated to safety. The site is only available in English, the same language used for all the reports. The Annual Safety Performance Review, published on annual basis from 2011 to 2020, is the document of interest for this study, in particular those of 2015, [16], 2016, [17], 2017, [18], 2018, [19], 2019, [20], and 2020, [21]. The 2019 release is only available as an e-reader, a kind of digital book, while the 2020 document is available both as an e-reader and in the classic PDF form. The document seems to be well done and pleasant to read, the data is presented with simple and effective graphs in addition to illustrative and simplifying images. Analyses and statistical trends are divided into categories (e.g. fixed wing commercial, commercial helicopter, air navigation services and aerodromes), each with its own chapter. Extensive use is made of the ADREP taxonomy and SPI indices, particularly for the last a large number of indices are used, depending on the category of interest. The bar graphs illustrate for each category the trend during the last three years up to the corresponding one of the Safety Review, the specific annual performance and the general one taking into account the last four years, e.g. in the 2020 document the trend is first analysed for the three-year period 2017-2019, then for the single 2020 and finally for the period 2017-2020. There is also a separate analysis of the reports received, divided into categories, and the respective Top Event, as well as a concluding part where safety issues are identified for each category according to the data available for that specific year.

Latvia's Safety Reviews are available on the website of the national civil aviation authority (Civilās aviācijas aģentūra). The site is available in English as

well as in Latvian. The documents are all collected within the tab Publications and Reviews, however in the English version the first one available is related to the year 2014, before the introduction of the publication mandatory by the Regulation 376/2014, [3]. In the local language version all those from 2007 to 2020 are available. The documents relating to the period under review are those referring to 2015, [22], 2016, [23], 2017, [24], 2018, [25], 2019, [26], and 2020, [27]. The statistical analysis carried out by the authority is based on the use of some SPI indices, approximately ten in number. The data are presented in the form of bar graphs: first a comparison with the previous year is illustrated, with the aim to highlight the change on an annual scale, and then the data referred to a quarterly division of the year in question is shown. It is worth highlighting the in-depth analysis conducted by the authority on accidents and incidents that occurred within the national territory, normalised on the number of flight hours, with the identification of the trend since 2011 and a draft accident analysis for drones, which is still elementary but only a few countries make reference to it.

In the case of Sweden, the task of producing and publishing annual Safety Reviews as required by the regulations is assigned to the Swedish government authority Transportstyrelsens, which deals with aviation but also with land transport, including railways and ships. It should be noted that the last factor also appears within the annual Safety Review document, as there are at least two chapters entirely dedicated to the analysis of safety in maritime transport. It is possible to assume that this influence is a cultural impact of the importance of shipping in the Baltic countries. The editions for the period of interest are those of 2015, [28], 2016, [29], 2017, [30], 2018, [31], 2019, [32], and 2020, [33].The one from 2019 is the first one related exclusively to aviation.
The most recent document, the one referring to the year 2020, contains a statistical analysis of the number of accidents in national territory normalised to one hundred thousand flight hours, with data from 2005 to the corresponding year of the report, and identification of the trend. A selected number of SPIs are also analysed, but they are translated into Swedish, which makes it difficult for those who do not know the local language to read the document quickly. It is worth highlighting the statistical analysis of the number of incidents involving drones, with data from a relatively recent period, 2016, and an exclusive paragraph for the consequent measures adopted, in order to emphasize the salient points with the aim of improving national safety.

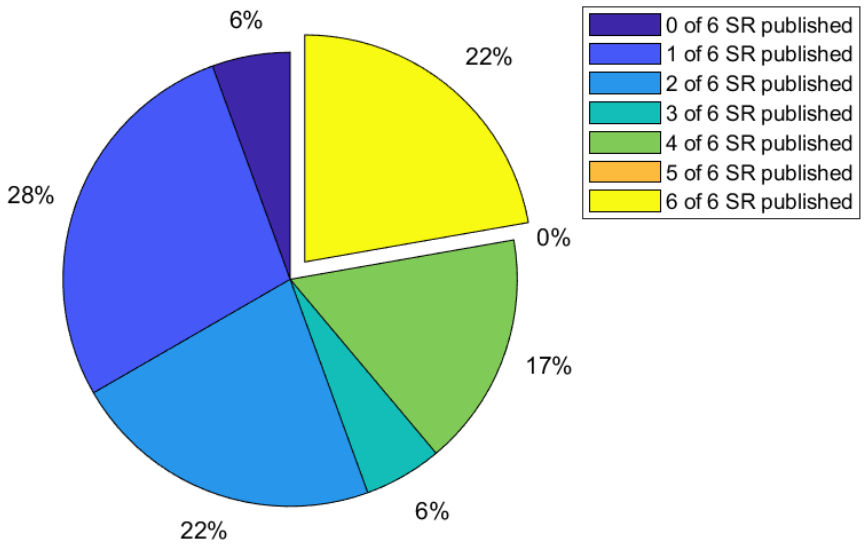

Figure 2.2: Countries that have published all Safety Review from 2015 to 2020

2.1.2 Netherlands, Slovakia and Swiss

The countries that have published 4 SRs are: The Netherlands, Slovakia and Switzerland.

The Dutch case is the most interesting one. The agency in charge of the Dutch Safety Review is the AnalyseBureau Luchtvaartvoorvallen (ABL), which is part of the Inspectie Leefomgeving en Transport (ILT). Every month, the ABL compiles the number of events reported by Dutch civil aviation and processes this data in a dashboard. The website, [34], is updated quarterly by the ABL. It is possible to consult the data made available in the form of a bar chart according to the SPI indicators with which they are divided. Within the page of interest it is possible to see the number of occurrences on a monthly basis and divided by severity. It is also possible to view the areas of interest for the respective events, thanks to a map of the Netherlands also present on the same page. For each SPI it is possible to filter the data either by a secondary topic, by type of aviation or by airport. Each table of each indicator is also available for download by third parties, and for each SPI there is also a quick explanation of its definition and

how the data are divided by the Dutch authority. A system created in this way, even if a real document is not published annually, is much more dynamic as it is updated on a quarterly basis and meets the requirements of the legislation. The only weaknesses of the website are that it is only available in Dutch and there is a limited number of SPIs analysed compared to Safety Reviews of other countries.

The Slovakian Safety Review is produced by the Civil Aviation Agency of the Republic of Slovenia. Their website is available both in English and in the local language and it is easy to access. There is a specific section in the main menu that deals exclusively with Aviation Safety, so it is very simple to find the Safety Review. It should be noted, however, that in the English version there is a notice stating that the first SR prepared by the agency is that of 2016, but there is no trace of it; it is necessary to access the same page in the Slovak version to find the four documents published so far: the one of the year 2016, [35], that of the year 2017, [36], of 2018, [37], and of 2019, [38]. The documents seem well produced, in addition to the analysis of accidents and incidents that occurred in the corresponding year, them also include references to the ADREP taxonomy and the use of SPIs for analysis and identification of statistical trends. There is also a brief mention of drones, which will soon become an important topic in civil aviation and their problems will also have to be managed at a safety level. The only shortcomings that can be highlighted in the work of the Slovakian CAA are the traceability of these documents only in the local language, they are written entirely in Slovakian, and the fact that they are not digital, i.e. it seems that the document has been printed and scanned in order to make it available also in a digital format. With regard to this last aspect, it is important to point out that the one relating to the year 2019 is no longer in this way, i.e. the digital version of the original file has been made available. A factor that increases its accessibility as it is easier for the end user to translate if he or she is interested and highlights a continuous search for improvement on the part of the National Authority from the safety's point of view.

In Switzerland, the situation is slightly more complex, due to the wide variety of languages recognised by the Country as 'official' and the large socio-cultural diversity present, which should not be underestimated. The site of the Federal Office of Civil Aviation (FOCA) - the national safety agency - is available in more languages than the other cases analysed so far: German, French, Italian and English. From the German and French sites, it is possible to see how the safety culture is well rooted within Swiss society. Since the first safety report dates back to 1998, it is necessary to go as far as 2017 to find a Safety Review that complies with the standards set out by Europe in Regulation 376 of 2014, [3]. The documents can be found in all versions of the website under the Annual Reports page, [39], but they must be downloaded in order to consult them. The Safety Reviews present are

those for the year 2017, [40], 2018, [41], 2019, [42], and 2020, [43]. The documents, after a brief introduction on the work of FOCA, proceed to illustrate the level of safety achieved at world level - thanks to the reports published annually by the International Air Transport Association (IATA) - and at national level. Proceeding then to briefly analyse the reporting culture at a national point of view before moving on to a statistical analysis and identification of trends for the SPIs used individually. It should be noted that the 2017 and 2018 documents do not contain any graphs or tables, which is disadvantageous to a clear representation of the analysis. The last two versions - 2019 and 2020 - have improvements in this respect as clear graphs are introduced to represent the data analysis study and a better definition of the SPIs to be used. Concerning this last concept, it is useful to highlight how the Swiss authority uses cards in order to divide the occurrences into five different operational categories (aerodrome operations, air traffic management, flight operations, helicopter operations and technical) and eight safety risk areas. The issues related to each operational category is linked to the safety risk areas of interest, in order to build a sort of matrix. This method is useful to extend the concept of SPI, making reporting more objective on the basis of occurrence, but it is necessary to define the safety issues for each category beforehand in order to reduce the subjective component as much as possible. The corresponding bar chart is then illustrated for each card, regarding the number of occurrences recorded divided between a high level of severity (i.e. accident, serious or major incident) and a low level (occurrences classified as significant/no safety impact/not determined).

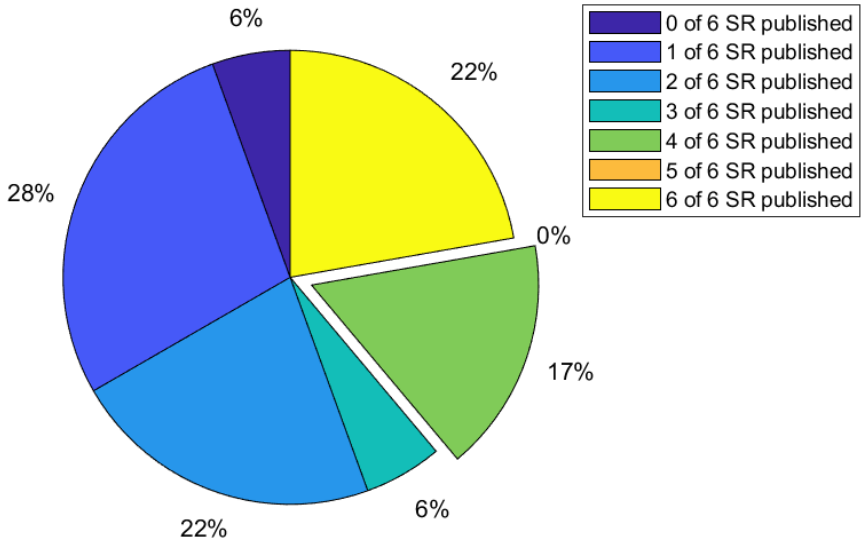

Figure 2.3: Countries that have published four Safety Review from 2015 to 2020

2.1.3 Spain and Italy

The only Countries to have published half of the required Safety Reviews are Spain and Italy.

Spanish documents can be found on the government website of the Agencia Estatal de Seguridad Aérea (AESA), unfortunately only the Spanish version of the website is available, as the SRs are written entirely in the local language. From what one learns from the Spanish website, the government authority used to be supported by a collegial inter-ministerial institution, Comisión de Estudio y Análisis de Notificaciones de Incidentes de Tránsito Aéreo (CEANITA), whose purpose was to provide advice and cooperation to AESA and to the Aeronautical Major Staff of the Ministry of Defence; this institution has apparently been disbanded. It is therefore possible to find three publications within the period under review, the one referring to the year 2015, [44], the one for 2016, [45], and the last one for 2017, [46].
Within the first two, in addition to the usual statistical analysis of accidents and incidents on Spanish territory, it is possible to find an interesting overview of the reports received by the agency: starting from the evolution of the total number

of reports up to the way they are reported and their division between mandatory and voluntary. So far, no country has performed a similar analysis, it could be a useful tool to evaluate a country's reporting culture, although Spain itself has decided to abandon it with the 2017 document. The data and trend study for accidents and incidents, on the other hand, is conducted according to indices that are somewhat similar to the SPI, although they are different as they appear to have been translated into Spanish. A factor that is definitely not to benefits a greater accessibility of the document. The data are normalised according to indicators shown in the report and are divided by region of interest: external factors, safety and prevention, airworthiness, flight operations, airport environment and air navigation. The 2017 document is slightly different to the previous two: the analysis of reports and the division into regions of interest is missing, focusing more on a division by occurrence's severity.

The Italian documents are all available within the online platform, [7], created by the Italian national authority Ente Nazionale per l'Aviazione Civile (ENAC). The documents and the portal are available exclusively in English, which is a major advantage for international users. The peculiarity of the Italian documents is that they always refer to the five-year period preceding the date of publication of the Safety Review: for example, in the document published during 2020 for the statistical analysis of events there are data from 2015 to 2019 (for accidents this time limit is longer: from 2008 to 2019).
The accessibility of the Safety Portal, as defined by the Italian authority, within the main ENAC website is quite simple. Although the site is available in Italian and English, it is immediately pointed out that only some of the thematic sections of the website are available in English, safety is one of them. Once the thematic area has been chosen among the six proposed on the main page - Safety & Security - it is possible to find access to the Safety Portal in the sub-section Safety Report of the paragraph concerning Flight Safety.
Inside the portal, data from 2015 to 2020 are available for a wide variety of SPIs, which are briefly described. The figures are illustrated in the form of bar graphs, whose data are either normalised per 10,000 movements or the total number of occurrences for that index is shown. In addition to the data illustrated in the portal, there are also old Safety Review documents: the one for 2016, [47], the one for 2019, [48], and for 2020, [49].
Navigation within the website is simple and intuitive, and the graphs are well illustrated and designed, although they are not as dynamic to read as those of other countries that have decided to follow this approach some time before.

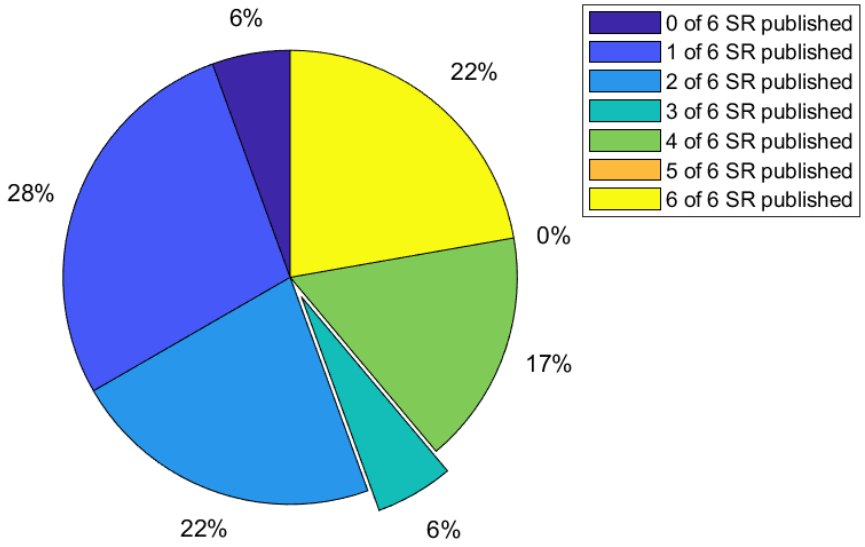

Figure 2.4: Countries that have published three Safety Review from 2015 to 2020

2.1.4 Finland, Belgium, Poland and Romania

Four countries published two Safety Reviews in the study period: Belgium, Finland, Poland and Romania.

The Belgian Safety Review is the first one to have a fundamental difference to the previous ones: it is not an exclusive publication but is treated as an update within the national Aviation Safety Plan. The one referring to 2018 can be found within the Safety Plan 2016-2020 - update 2018, [50], while the 2020 one is published as an update of the Belgian Plan for Aviation Safety 2020-2024, [51]. They are both prepared by the Belgian Civil Aviation Authority, which is part of the Federal Public Service Mobility and Transport. They are not exclusive publications, as required by the regulations, in fact they are not even named Safety Review, but the data collection carried out by the Belgian authorities is coherent and all data are represented monthly and divided in SPIs. Within the documents there are also data from previous years, each report presents data up to the year before its publication - i.e. within the 2020 edition there are data up to 2019 - so even if no publications were made in the other years, a data collection and analysis was carried

out. Both releases are available in French and English, it is a fundamental factor to increase their accessibility by users. In addition, on the Civil Aviation Authority's website there are interesting publications, almost annually, on an in-depth analysis of Airspace Infringements on Belgian territory.

In Finland, the Finnish Transport and Communications Agency (TRAFICOM) is the responsible authority for publishing the Safety Review. Its website is available in three versions: English, Suomi and Svenska. Since there are so many topics covered within the same site, it may be a little complicated to find the page dedicated to aviation safety, although this is not really the case since it is quite easy to find it once the subsection dedicated to aviation is found. In this case the peculiarity is that no physical document is published, but all the discussion is done by the agency online, on its own site. On the Safety Reviews webpage, [52], there are both the 2019 and 2020 cases. It is plausible that only the reports from the last two years remain public and the last one is removed when the new version is added. Each Safety Review is divided into several parts, each with its own web-page. Each page deals with a specific topic, ranging from statistical analysis of accidents and incidents in Finnish commercial aviation, through recreational aviation to studies concerning domestic reporting and accidents/incidents according to the adopted SPIs. The graphs shown within the various analyses are dynamic and intuitive, making them easy to read and accessible. There is also a tab for all the definitions of the concepts that are used within the SR, e.g. a short definition for each single SPI. The document is present either in English or in Finnish: which is a crucial factor to increase the accessibility of these documents to third parties who are not able to understand the local language.

For the Republic of Poland, the Safety Reviews available on the website of the competent authority - Urząd Lotnictwa Cywilnego (ULC) - are the one for the year 2017, published in 2018, [53], and the one for the year 2018, made available in 2019, [54], there are no other similar documents. The site is available in Polish and English and in both versions it is possible to find the highlighted documents, which is an advantage in terms of their accessibility, however both reports are only available in the local language. In both cases an in-depth analysis is carried out: starting with the continuous increase in the number of movements through the country, continuing with an analysis of the accidents and incidents that have taken place, and ending with a specific analysis of the SPIs. The indexes used are explained as well as their relative risk. Within the SPIs' analysis, the data relate to reported incidents and are not normalised. They are normalised according to the number of movements inside the accidents and incidents' study. There is also a special focus on helicopters and airports, where different indices are used than for civil aviation. The topics treated within both documents could appear

to be dispersive, together the reports add up to more than 440 pages. It would certainly be preferable to have more concise documents but with greater regularity and frequency, as required by European legislation.

With regard to the Romanian case, the national CAA published a total of three documents called Annual Safety Review, covering the years 2014, 2015 and 2016. Only the second, [55], and the third, [56], are within the study period considered from 2015 to 2020. The website of the competent authority is available in English and Romanian, so the reports are easily accessible, but the language used for the documents is different: they are only available in the local language. The releases under consideration present an analysis and study of the trend in the number of accidents and incidents over the last three years up to the date of publication, but there is no trace of the SPIs. The situation is different if one analyses the documents called Safety Risk Portfolio Regarding the Romanian Civil Aviation, which are published in three different editions that cover the years 2018, [57], 2019, [58], and 2020, [59]. Within these reports there are statistical analyses of incidents and a use of fundamental SPIs illustrated within it, as required by European legislation. Not calling them by their appropriate names could cause confusion, although it cannot be said that the Romanian authorities do not meet the requirements set out by the European Parliament in Regulation 376/2014, [3]. In addition, both versions of the website include a more in-depth analysis of bird strikes and wildlife occurrences, which are carried out in the local language from 2011 to the most recent version in 2020.

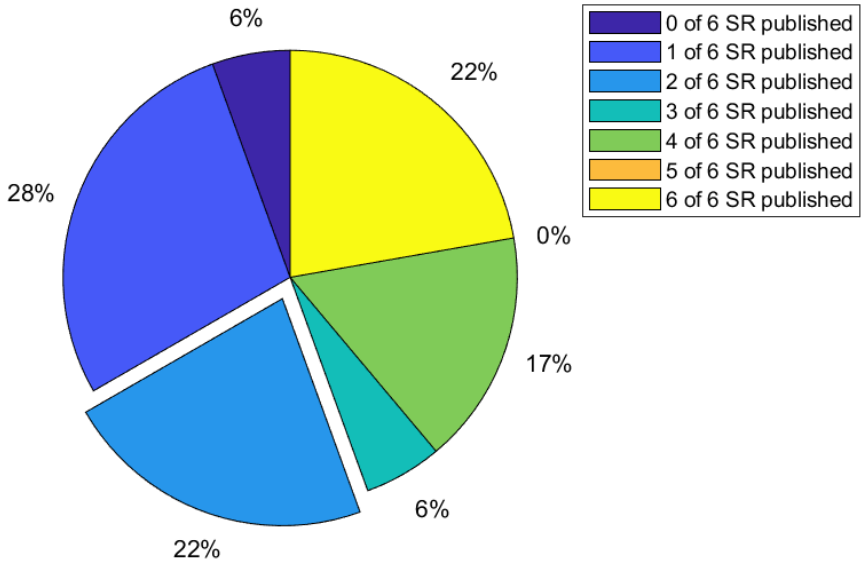

Figure 2.5: Countries that have published two Safety Review from 2015 to 2020

2.1.5 Austria, Lithuania, Malta, Norway and Portugal

A total of five countries have published only one Safety Review: Austria, Lithuania, Malta, Norway and Portugal.

While the first four countries have recently published a Safety Review, the situation is different for Portugal. In the Portuguese case, there is an SR for the year 2013, which was published in 2015 on the website of Autoridade Nacional da Aviação Civil (ANAC), the national competent civil authority. There are no other more recent publications. This document is referred to in local language as Relatório Anual de Segurança Operacional (RASO), [60]. It is written entirely in Portuguese and has references to SPI indices and ADREP taxonomy. When questioned about the possible existence of other similar documents on the same platform or not, ANAC replied that the only public SRs are those published on their website.

The Safety Review of Lithuania, [61], is a task of the Transporto Kompetencijų Agentūrą (TKA). The TKA website is available in both English and Lithuanian, although there are differences between the two versions. Some pages and articles

are exclusive to the local language version and are absent from the translated one. Among them there is the only Safey Review published so far, covering the year 2020, which is not on the translated site but only on the original one, so its accessibility is limited. Within the document there is data not only for the year 2020 but up to 2017, which shows that a data collection has been carried out although no SRs have been published before this. The analysis that is carried out on accidents and incidents is normalised to 1.000 or 10.000 flight hours, depending on the type of aircraft. The ADREP taxonomy is referred to, but SPIs are missing, not even mentioned. The fact that the text of the document cannot be selected or copied makes it difficult to read for those who do not know the local language, as it is written entirely in Lithuanian, making its translation hard.

In the case of Malta, the report is produced by the government department Transport Malta. The Safety Review published on their website, [62], is easy to find, as the website is in English and user-friendly. The document is written entirely in English, making it easy to read for all users, not just local ones. There are references to both the ADREP taxonomy and the use of SPIs, while the data collected is based on the number of occurrences per year and it is not normalised by number of accidents and/or flight hours. Although only the one covering the year 2020 is present, it is possible that each new publication replaces the old one. Within it there is data up to 2017, so there was also data collection in previous years. Both the SPIs used and their targets - i.e. the future objectives to be achieved - are presented, defined not by the probability of occurrence of that individual event but by its risk.

The Norwegian case, on the other hand, presents some similarities with the Lithuanian case, although few differences are notable. Starting with the national CAA website, Luftfartstilsynet, which is available in both local and English, in the translated version there is no trace of the Safety Review, only of the State Safety Program. The SR, [63], can only be found in the local language website, which is the same as the one used to write the document. Although just the one referring to the year 2019 is present, there is a large amount of data collection within it, starting in 1946 for the analysis of fatal accidents. The data collection becomes more specific from 2014, where accidents are divided by severity and by aircraft category. There are references to both the ADREP taxonomy and SPIs, with the last one being related to the number of occurrences and not normalised in any other way. There is also a special focus on helicopters - offshore and inland - with relative analysis according to the SPIs also used for civil aviation. There are also more in-depth analyses for specific topics, in particular runway incursion, dangerous goods and fatigue failures. Probably only one Safety Review is available because the publication is replaced annually by the most recent one, no archive is available.

In Austria, the task has been assigned to the company Austro Control, which is responsible for the coordination and regulation of air traffic through Austrian airspace. The website of the company is available in German and English, and in both versions it is possible to find the document for the year 2017, [64]. Only the report for that year can be found there, however the company itself justifies this with a statement on the website saying that the amendment of the Austrian Aviation Act in 2017, paragraph 136 (5), designated Austro Control to publish the Safety Review for Austria. Therefore, the first and only publication to date is for 2017, while Safety Reviews for following years will be published promptly after approval by the Austrian Aviation Safety Programme Board, which apparently has not yet taken place. Although there is only one SR currently available, there is a summary document on occurrences from 2013 to 2017, [65], so data collection and analysis has been done in previous years, even though there are no SR publications about it. The Austrian Safety Review is written entirely in German and, after a brief initial introduction on the legislation, it presents a series of data collection on accidents and incidents on Austrian territory, with a study of the different trends according to the ADREP taxonomy. There is no analysis according to the SPI, which is present in the other document.

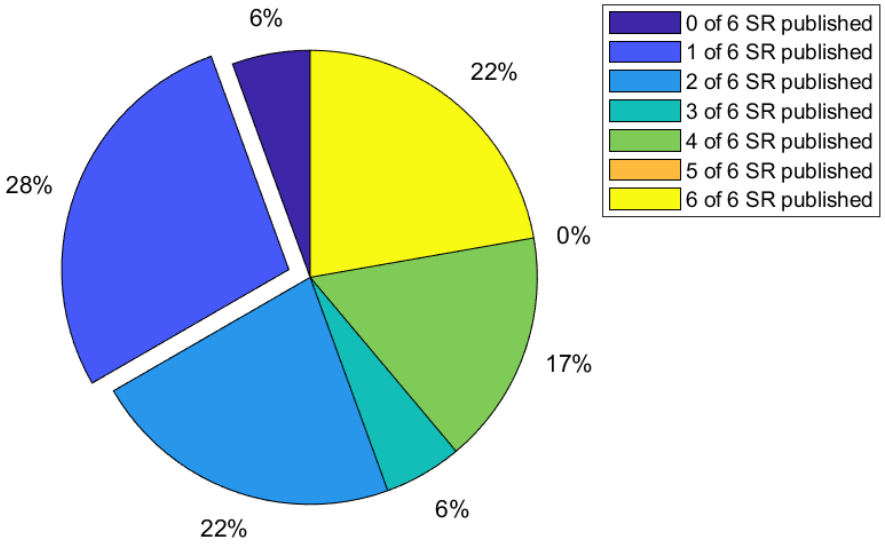

Figure 2.6: Countries that have published just one Safety Review from 2015 to 2020

2.1.6 Hungary

There is only a country from which a public Safety Review could not be found in the period 2015 - 2020: Hungary.

The site of the Hungarian competent civil authority on the EASA platform is unreachable, it is necessary to make further searches to find the working one, although it is not unique. There are two portals for the national transport authority: the first one is available in both Hungarian and English, whereas the second one is only available in the local language.
Within the first site, [66], it seems there is some information available on the aviation authority, but a closer look reveals that there is only training instruction and flight licence examinations.
The second site, [67], is only available in the local language. It would appear to be the one responsible for national aviation safety, as there are also documents available on it, but there is no trace of Safety Reviews being published.
It was not possible to verify the availability of these documents, if they really exist

and have been published according to the legislation. The impossibility of accessing the competent authority's website directly from EASA, the lack of clarity as to which official portal is used to find this information in addition to the absence of a translation of the website are critical elements that cannot be ignored.

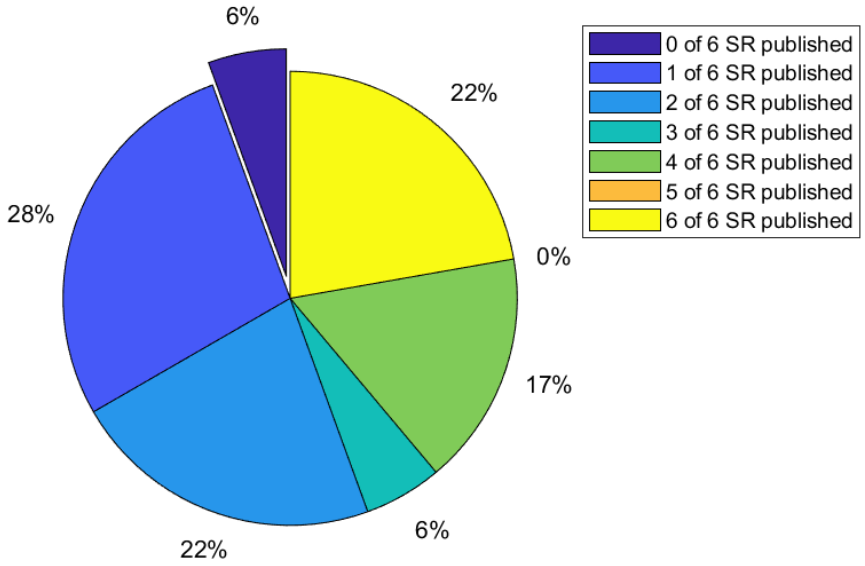

Figure 2.7: Countries that have not published Safety Reviews from 2015 to 2020

In conclusion, this chapter has shown that the current situation in Europe is not unique, some countries fulfill their obligation to publish annual Safety Reviews, while some others haven't reached this target yet. Approximately 56% of the countries analysed (10 out of 18) have published less than two out of the six required documents, which means that more than half of the countries have only completed one third of the required work.
Furthermore, from the brief commentary of each case, the absence of a true standard for writing the reports can be seen. The guidelines outlined by EASA prove to be incomplete in certain aspects, leaving individual organisations free to choose in some areas, which is a disadvantage in terms of accessibility and availability of Safety Reviews and the exchange of information between countries, which are the key objectives of Regulation 376/2014, [3].
This scenario - with some very good exceptions to mention such as France, Ireland, Latvia and Sweden - highlights that there is a lack of control by the legislative

agency - EASA - over the actions of its subordinates, or that this control is obsolete or ineffective.
After defining the general scenario, including the main highlights and shortcomings of each case, it is necessary to go deeper into the analysis. To this purpose, in the next chapter a series of Safety Reviews among those published in 2019 will be analysed in more detail, illustrating the main features of each document.

Chapter 3

In-depth analysis Annual Safety Review 2019

After analysing the individual cases by the number of published Safety Reviews, it is important to examine the individual documents for a reference year, in this case 2019, in order to highlight the main similarities and differences between the documents of the different countries. This year was chosen instead of 2020 because of the complexity due to the COVID-19 pandemic effects and the incompleteness of 2020 reports, which are still being published.
Below there is a list of the countries that published a Safety Review or a similar document in 2019; in the case of Romania, the second edition of the Safety Risk Portfolio Regarding the Romanian Civil Aviation is taken into account and not the Annual Safety Review, since the last one was published under this name until 2016:

- Finland
- France
- Ireland
- Italy
- Latvia
- Norway
- Netherlands
- Romania
- Slovakia

- Sweden
- Swiss

The countries have been listed in alphabetical order. Below the five cases considered to be of most interest for the final purpose of this study will be analysed.

3.1 Finland

The Finnish Safety Review is written by the national authority Traficom and published digitally on its website, [52].
For the 2019 edition, it consists of six main chapters:

- Safety of commercial air transport: which analyses the number and trends of accidents and fatalities and the number of serious incidents in Finnish commercial aviation;
- Safety of general and recreational aviation: which analyses the number and trends of accidents and fatalities and the number of serious incidents in Finnish general and recreational aviation;
- Safety performance of other aviation domains in 2019: the same analyses as in the previous chapters are carried out but for ATC, aerodromes, ground handling and drone activities;
- Reporting: where the trend in the number of reports over the last thirteen years is analysed, as well as the distribution of incidents according to aviation domains;
- Traficom's work to improve safety: detailing the many initiatives taken by the national authority to improve safety in 2019;
- Safety Review based on Tier 2 indicators: an analysis of national safety performance based on Tier 2 indicators, which are the most significant causal factors of accidents.

With regard to commercial aviation, it can be seen in the respective chapter that in the year 2019 the number of accidents was zero, while ten serious incidents occurred, which corresponds to a decrease compared to the previous year (12) but still a considerably high number compared to the long-term average (6 from 2013 to 2018).

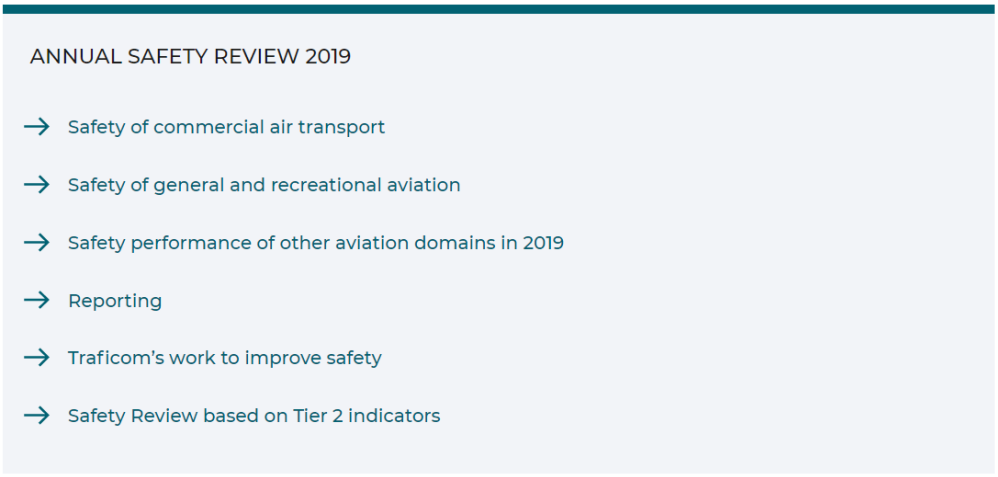

Figure 3.1: Chapters of the Finland's Annual Safety Review 2019

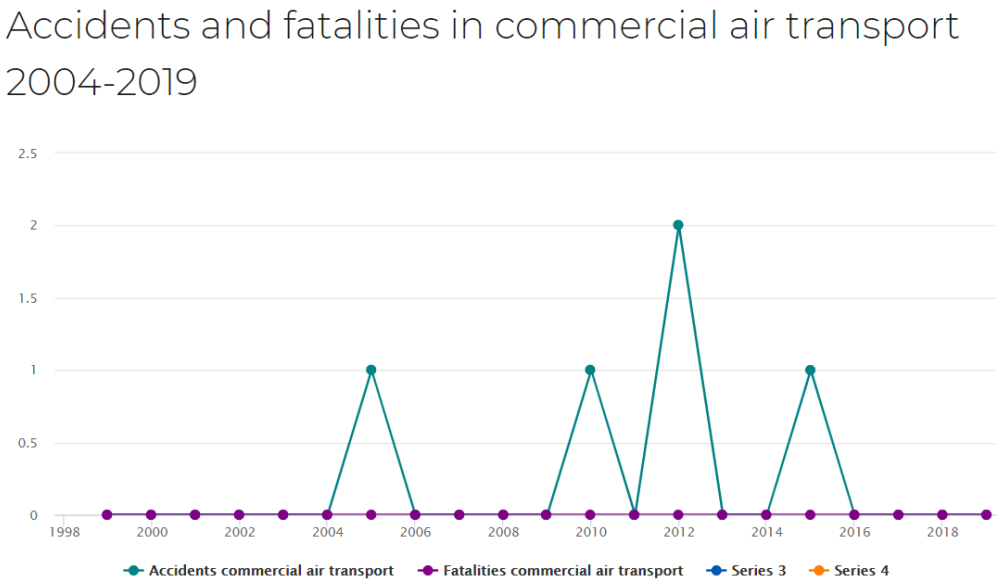

Figure 3.2: Accidents and fatalities in commercial air transport 2004-2019

It should be noted that most of the isolated events classified as accidents occurred in connection with sightseeing flights, business aviation and cargo operations. Incidents involving Finnish scheduled flights are extremely rare.
Accidents and serious incidents are analysed annually on the basis of information on the number of hours flown collected by the Finnish authority. In 2018 the number of flight hours in commercial aviation was 281,749 so the imputed number of accidents in the period 2006-2018 would be approximately 0.01 accidents per

10,000 flight hours. In 2019, flight hours remained about the same as in 2018, indicating a probable increase in domestic traffic at the beginning of the year, slowed by the COVID-19 emergency towards the end. The major effects of the pandemic will likely be seen in the Annual Safety Review for the year 2020.

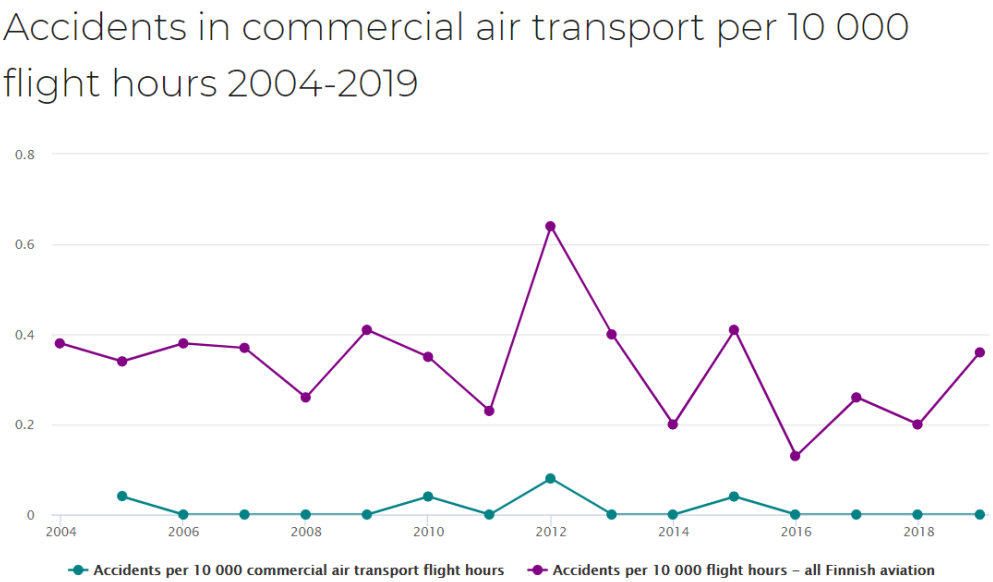

Figure 3.3: Accidents in commercial air transport per 10 000 flight hours 2004-2019

From the chart above (Figure 3.3) it can be seen that the number of accidents due to commercial aviation is almost limited compared to the total annual number collected by the Finnish authorities. This trend also has an impact on the number of fatalities, although a single incident in commercial aviation may result in more fatalities than one in other aviation domains, as is underlined by the year 2005 when there was a single incident in commercial aviation, resulting in a higher number of fatalities normalised to flight hours than in other cases, as shown in the graph below (Figure 3.4).
Concerning serious incidents in Finnish commercial aviation, there were ten in 2019, a number slightly lower than the twelve that occurred during the previous year, but significantly higher than the long-term average of six from 2013 to 2018. Half of the serious incidents were due to the incredible increase in events caused by drones during approach operations at Helsinki-Vantaa Airport in the spring, although this number was down from the previous year. All those cases where the drone was so close to the aircraft that a possible collision was only avoided by luck were reported as serious incidents.

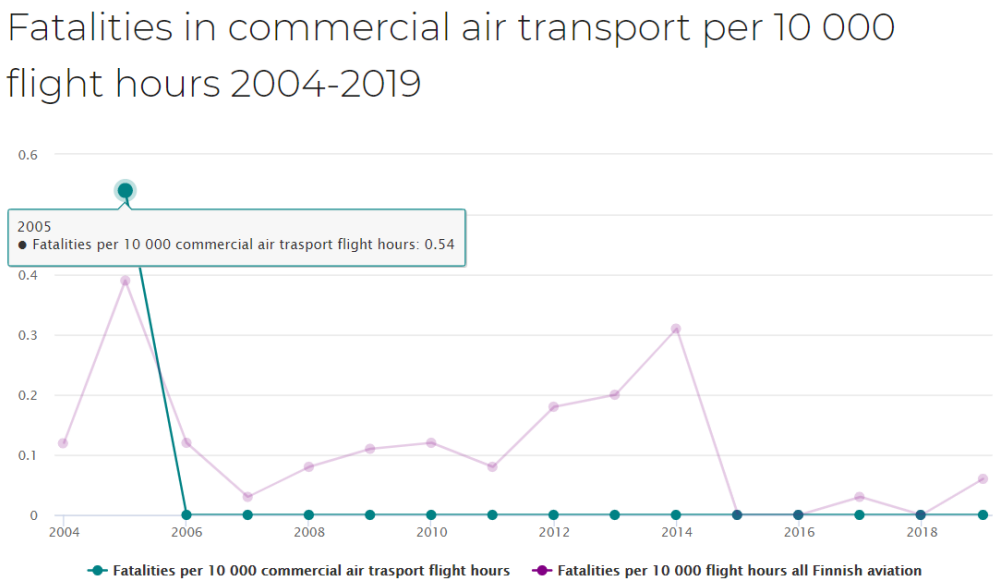

Figure 3.4: Fatalities in commercial air transport per 10 000 flight hours 2004-2019

There was also a serious incident involving a foreign aircraft in which a Latvian airliner was involved in a runway excursion at Savonlinna airport. The National Security Investigation Authority published a report on this incident in December. The number of flight hours in commercial aviation was almost identical to the previous year, as there were fewer serious incidents, the ratio of serious incidents to 10,000 flight hours is lower in 2019 (0.4) than in 2018 (0.43), although they are clearly higher than the long-term average.

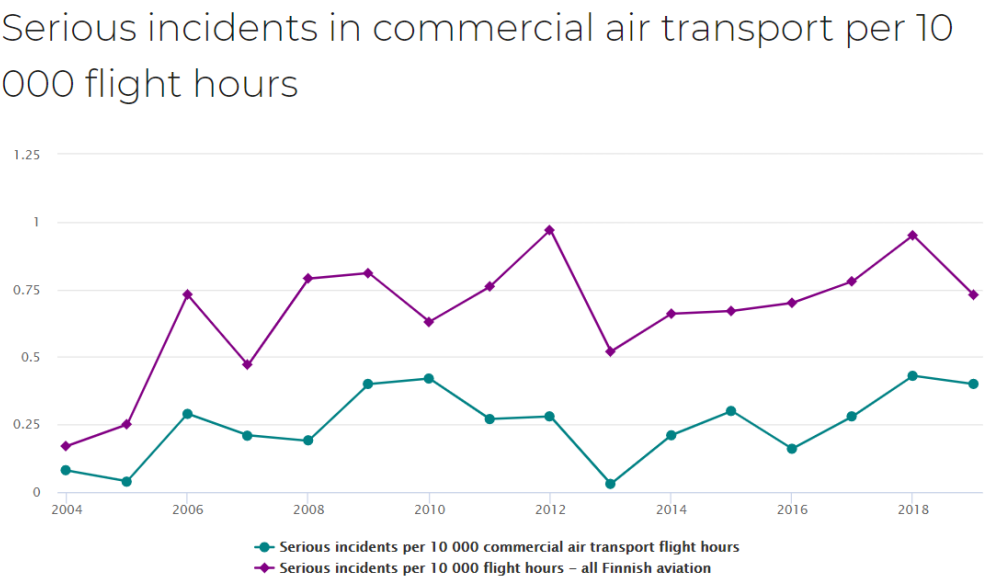

Figure 3.5: Serious incidents in commercial air transport per 10 000 flight hours

In Finnish general and recreational aviation, the year 2019 marked a slight deterioration in safety performance compared to previous years. There were 12 accidents, two of which were fatal, both accidents resulting in the loss of one life.
The last time there was a fatal accident in Finnish general and sport aviation was in 2017, so last year's safety performance was consequently worse than in previous years.
The total number of accidents was higher than the long-term average (9 in 2013-2018). Eight serious accidents were reported, which is half the number of the previous year and the long-term average. Loss of control, runway excursions and ground collisions were the most common causal factors in last year's accidents.

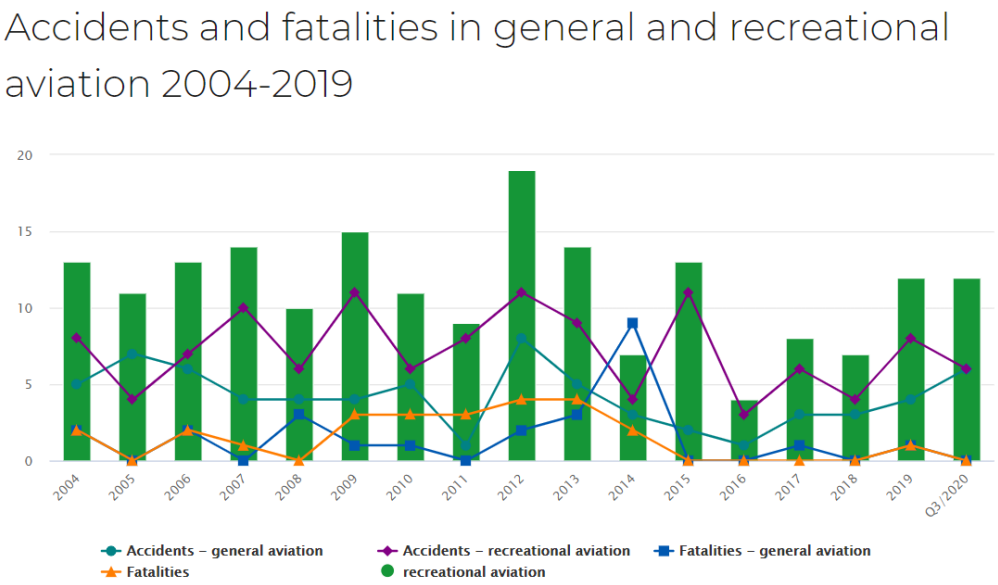

Figure 3.6: Accidents and fatalities in general and recreational aviation 2004-2019

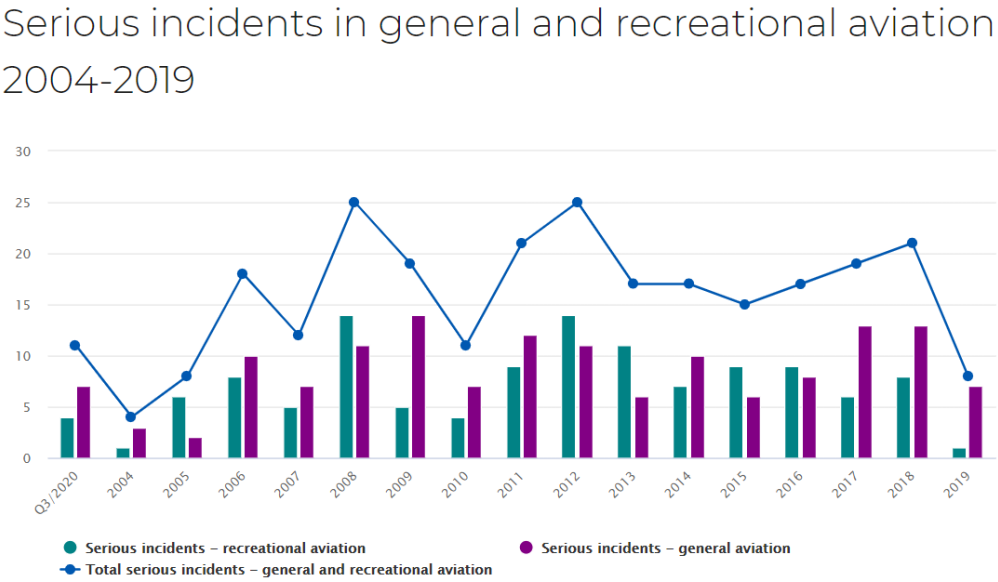

Figure 3.7: Serious incidents in general and recreational aviation 2004-2019

As regards the other aviation domains, the factors to be highlighted are:

- a slight increase in minimum separation infringements with ATC contribution during the year 2019. 47 cases were reported, which is also higher than the long-term trend of 38.5. The largest increase occurred in aircraft-aircraft and between aircraft and different types of controlled airspace violations. According to the available data, the volume of traffic increased at Area Control Centre Finland but decreased at airports;

- a decrease in runway incursions with ATC contribution events, whereby the number of occurrences decreased from 10 events in 2018 to 6 in 2019 with a particular decrease around Helsinki-Vantaa airport (from 5 to 2 cases), although the total number of events is roughly on par with the long-term average;

- a slight increase in the number of runway incursions caused by ground vehicles, the total number of events in 2019 was 18, slightly up on the previous year but significantly in line with the long-term trend;

- a constant increase in drone operations since 2015, a fact that has been reflected each year in the number of incidents during the approach phase of planes. In 2019, the increase in the number of reported near misses caused by drone operations marked a brief arrest from the previous trend stopping at 15 reported events in Finland, while this amounted to 23 the year before. Outside Finland, the number of incidents involving a Finnish aircraft and a drone was the same as last year (8). The increase in the number of near misses has continued for several years, and the fact that it has been slowed down in 2019 is a positive result, especially considering the increasing volume of drone operations. Also worthy of note are the initiatives carried out by the Finnish authorities in favour of this topic such as the creation of the Droneinfo app, as well as through newsletters and safety bulletins. This has evidently resulted in a better performance from this point of view and further improvement is estimated during the 2020 document.

Once the in-depth and accurate analysis on the number of accidents and serious incidents, mentioned in the Finnish report as Tier 1 indicators for the analysis of safety performance, is finished, there follows a further analysis on the most significant causal factors of the accidents, represented by the Tier 2 indicators.
These are - respectively - Runway Excursions (RE), Runway Incursions (RI-VAP), Airprox incidents (MAC), Controlled Flight Into or towards Terrain and similar situations incidents (CFIT), Losses of control in air (LOC-I) and Ground collisions (GCOL).

Runway Excursions is defined in the document as *"uncontrolled departure of an aircraft from a runway during take-off or landing. This may be unintentional or intentional, for example as a result of an evasive manoeuvre"*. This index is represented by number of cumulative occurrences along the year of interest, from January to December, as can be seen in the graph below (Figure 3.8). In 2019, eight runway excursions were reported to have occurred in Finland or involved Finnish aircraft, which is lower than in 2018 (12) and the long-term average from 2013 to 2018 (9.5). Most of the runway excursions occurred in general aviation, which has been a very typical condition in recent years. Runway excursions usually occurred during landing, where in many cases challenging wind conditions and the resulting steering error were a contributing factor.

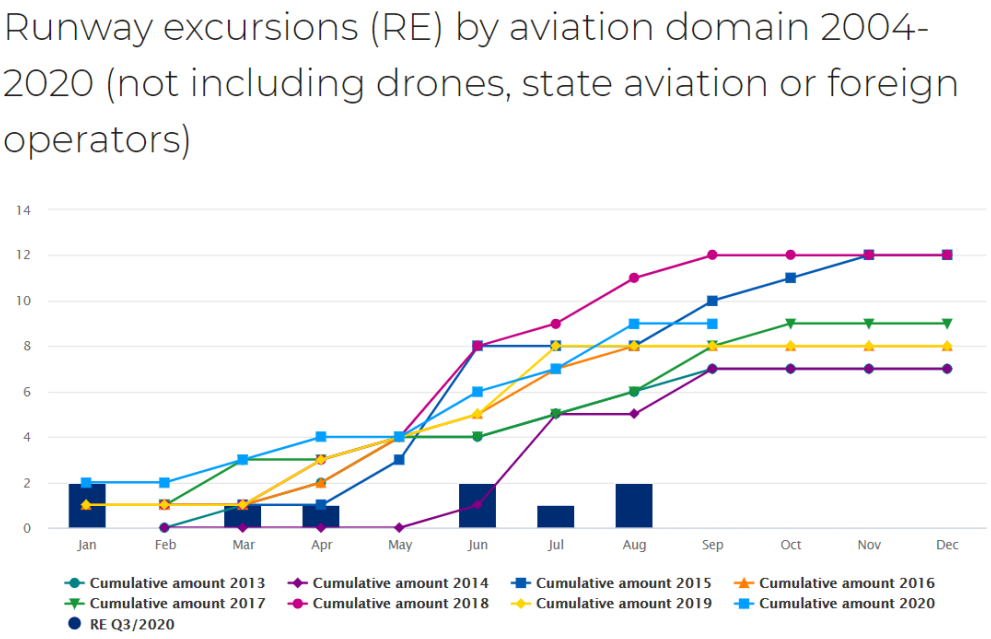

Figure 3.8: Runway excursions (RE) by aviation domain 2004-2020

Runway Incursions index is illustrated as *"any situation where an aircraft, vehicle or person is present on the runway or in its protected area, without authorisation or otherwise in an improper manner. This includes low-level approaches performed without authorisation or otherwise incorrectly"*. This concept is represented in Figure 3.9 as the number of annual occurrences subdivided by the most probable domain that contributed to its occurrence.
In 2019, 79 runway incursions were reported, which represents a sharp increase from the previous year (64) and the 2013-2018 average (64), ending the downward trend that had been occurring continuously since 2016. The number of runway incursions by aircraft (51) thus increased alarmingly compared to the previous year

(35) and also significantly exceeded the 2013-2018 average (41.3). Those caused by vehicles and people on the ground (26) increased slightly compared to 2018 (19) and exceeded the long-term average (16.2), while events with ATC contribution (6) decreased compared to 2018 (10) and was on par with the long-term average (5.5).

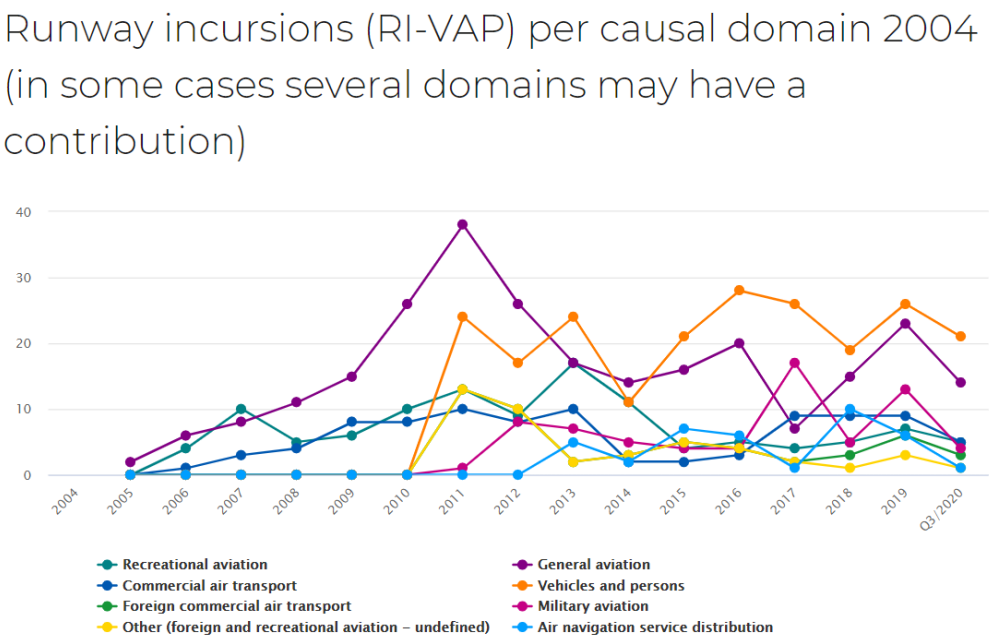

Figure 3.9: Runway incursions (RI-VAP) per causal domain 2004-2020

The MAC (mid-air collision) and near miss/AIRPROX index concept refers to a situation *"where aircraft in flight come into contact with each other or where the distance between the aircraft as well as their relative positions and speed have been such that the safety of the aircraft involved may have been compromised"*, still according to the definition within the site dedicated to accident analysis according to tier 2 indicators. A mid-air collision between aircraft would be a highly exceptional event, and fortunately none has been recorded in 2019. On the other hand, 82 Airprox incidents were reported to have occurred in Finland or to have involved Finnish aircraft. This trend represents a clear increase from the 71 cases in 2018 and the 2013-2018 average (49). While drone operations have been the most significant factor in the increase in the number of near misses, their growth seems to have stopped this year. During the year, 22 Airprox incidents caused by a drone were reported (including 15 in Finland), while the previous year this number was 27 (including 23 in Finland). Figure 3.10 shows the incidents per participant from 2004 to the third quarter of 2020.

Figure 3.10: MAC/Airprox incidents per participans 2004-2019

Controlled flight into or towards terrain and similar situations (CFIT/near-CFIT) are all those situations where *"an airworthy aircraft under the complete control of the pilot is inadvertently flown (or nearly flown) into terrain, water or an obstacle"*. In 2019, nine cases were classified as CFIT. This is clearly more than the 2013-2018 average (6.2) and almost double the number of cases in 2018, showing a clear growth. The graph below shows the annual trend of cases by aviation domain.

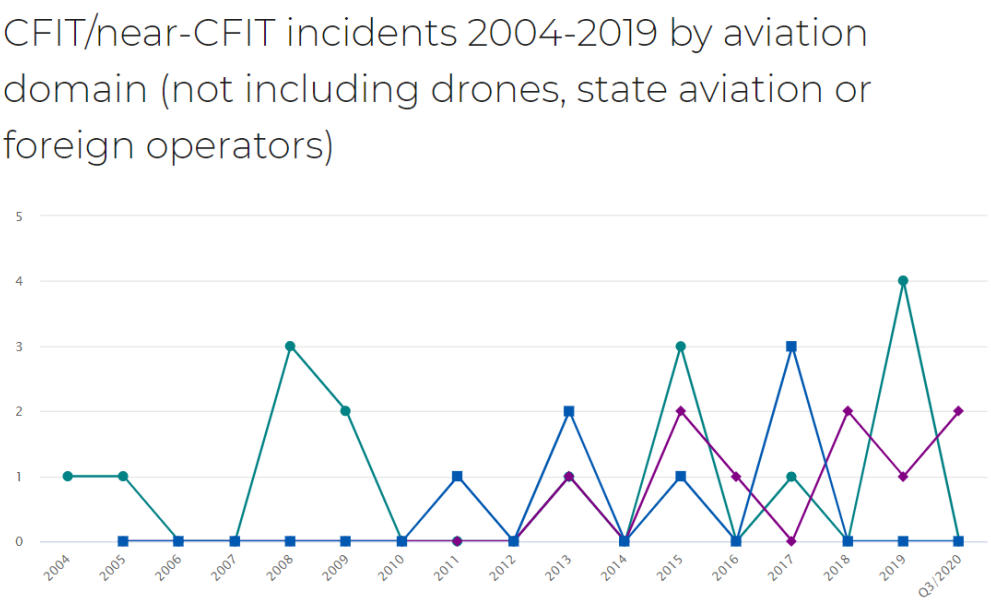

Figure 3.11: CFIT/near-CFIT incidents 2004-2019 by aviation domain

Loss of control in flight (LOC-I) is defined by the Finnish authorities as *"a situation where the pilot loses control of an airborne aircraft, resulting in a significant deviation from the aircraft's intended flight path. The loss of control may be total or momentary and caused by such factors as human error, mechanical faults or external factors"*. In 2019, 21 cases of loss of control in flight were reported. This number was slightly lower than in 2018 (31) but significantly higher than the 2013-2018 average (13.7). As in the previous year, the growth in the total number is explained by situations that occurred in drone operations (14). Excluding cases that occurred in drone operations, the number of LOC-I cases in manned aviation was slightly lower (8) than in 2018 (10) and similar to the 2013-2018 average (8.4). In commercial aviation, LOC-I cases are rare and not a single one was reported last year, with the majority belonging to general and recreational aviation and drones, as can be seen from the graph below.

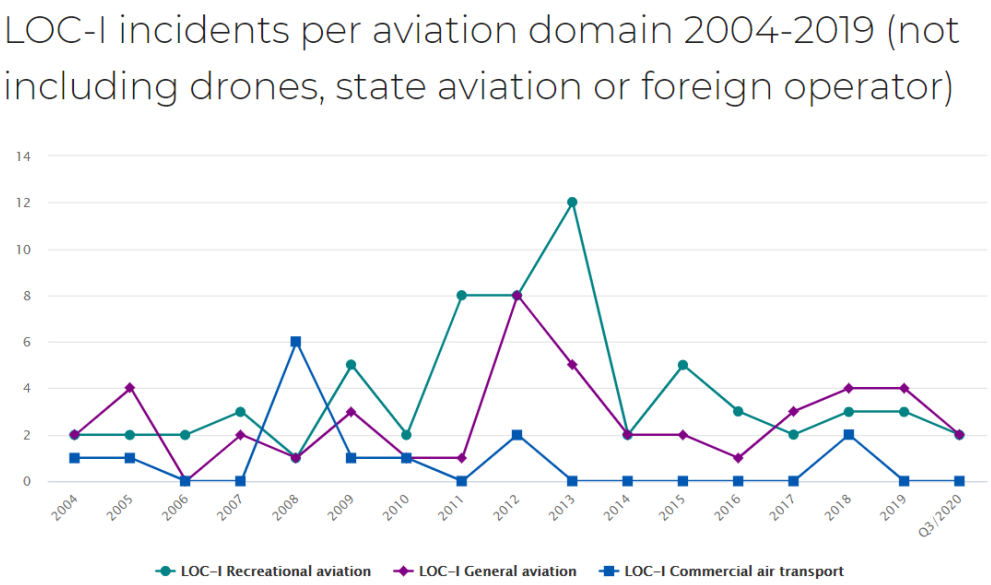

Figure 3.12: LOC-I incidents per aviation domain 2004-2019

According to the definition illustrated within the document, the GCOL (Ground collisions while taxiing to or from a runway in use) is the index that refers to a situation *"where an aircraft comes into contact with another aircraft, a vehicle, a person, an animal, a structure, a building or any other obstacle while moving under its own power in any part of the airport other than the active runway, excluding power pushback"*. The graph in Figure 3.13 illustrates the number of annual events associated with this index, and it can be seen that it is quite unusual for commercial aviation and that the trend is steadily declining. Only one collision was reported in 2019: while a general aviation aircraft was taxiing to or from the runway or area used for take-off or landing the propeller hit the ground. This number is significantly lower than the previous year (5) and also lower than the 2013-2018 average (2.5).

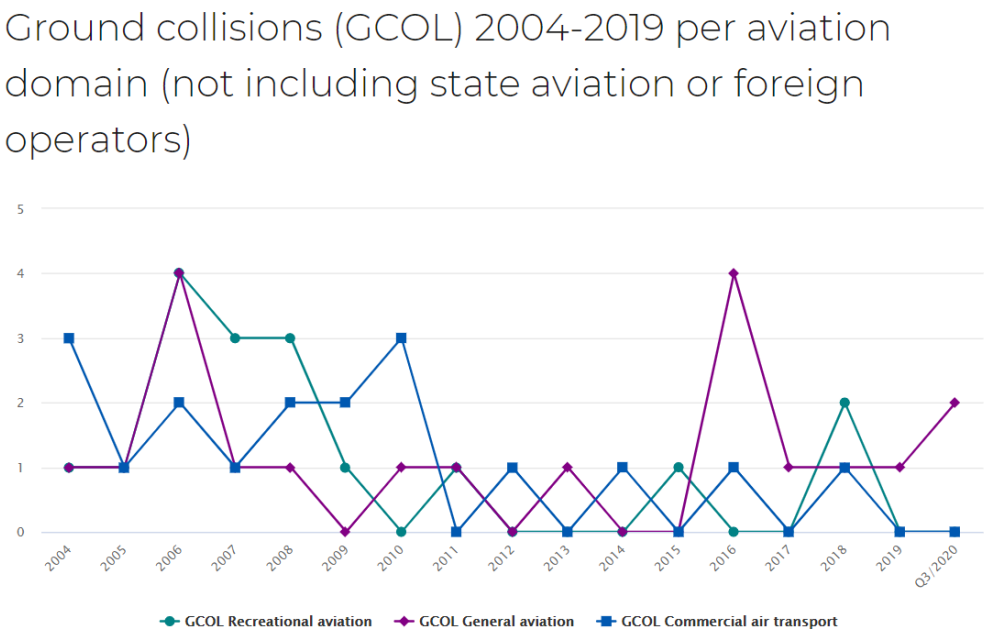

Figure 3.13: Ground collisions (GCOL) 2004-2019 per aviation domain

Another event that is highlighted in the Finnish Safety Review is laser interference, as it is an ongoing risk factor for air traffic. Laser beams can interfere with the pilot's vision during critical phases of flight, including take-off and landing, or when flying at low altitude. Laser pointers disturb the pilot's concentration and interfere with his vision, including temporary loss or blurring of vision and even permanent retinal damage.
The number of cases has decreased since 2015, which was the peak year of the decade, from 74 cases to 32 cases of lases interference reported in 2019 (14 in Finland and 18 in other countries), which is significantly lower than the average in 2013-2018 (53.7). It was noted that the number of cases tends to rise especially as the dark season approaches. Typically, laser interference is reported in the proximity of Helsinki-Vantaa Airport, with two out of three cases occurring while an aircraft is on approach.
The increase in laser interference is partly due to technological progress and partly to pure ignorance. The number of cases in Finland has been low compared to other countries, and the trend has also been declining in recent years. Within the Finnish document there is a table where a large amount of data on laser interference events is collected, for Finland as well as for other countries around the globe. In 2014 there were 1189 events in Italy, 1442 in the UK and 3894 in the USA compared to 66 cases in Finland.

In conclusion, it can be seen that the Finnish authority has divided its Safety Review into two main parts: one part in which a statistical investigation is carried out according to what they consider to be "Tier 1 Indicators", i.e. the number of accidents and serious incidents and their respective fatalities, and a second part which considers Tier 2 Indicators, at a lower level than the previous ones and made up of specially selected SPIs.
In the first part, which is the most common compared to the Safety Reviews of other Countries, an in-depth study is made of accidents and serious incidents and their causes and consequences. The data is collected and illustrated accurately and efficiently, in a concise manner but without omitting important details.
The second part, on the other hand, is more specific, using a number of SPIs which, according to the Finnish authorities, are the main cause of the incidents that constantly occur in the country. A total of six different types of SPIs are used. It can be seen that MAC/Airporx, RI-VAP and Laser interference are the most common types of SPI in the Finnish safety scenario with 82, 79 and 32 cases reported respectively.
It is also important to highlight how the national safety culture has been steadily growing since 2017: over the 13-year period it has increased from 1948 to 9300 reports, a growth of +477%. Having a widespread safety culture is a fundamental requirement for a safety oversight mechanism that relies on mandatory and voluntary reporting.

3.2 France

The document for the year 2019, [14], is available within the page of the Ministére de la Transition Écologique under the direction of the Direction Générale de l'Aviation Civile (DGAC).
This document is written entirely in French and is divided into three main chapters:

- the first one referring to aviation safety in the world and in Europe;
- the second whose main theme is aviation safety on French territory;
- the third illustrates the State's security programme and carries out an analysis of certain security issues.

Regarding the first chapter, the French authority points out that the data at its disposal come from two different main sources:

- the iStars database held by the ICAO;
- the Aviation Safety Network database, maintained by the Flight Safety Foundation, an independent, non-profit international organisation specialising in aviation safety research and promotion.

Within the first chapter, it is highlighted that in 2019, up to the time of publication of this Safety Review, a total of 8 fatal accidents had occurred within scheduled air services provided by aircraft over 2.25t, these accidents resulted in the deaths of 227 passengers. A year earlier, on the basis of the same criteria, there had been 10 fatal accidents in regular transport, resulting in the deaths of 488 passengers.

Date	Exploitant	Etat de l'exploitant	État de l'accident	Aéronef	Passagers tués	Membres équipage tués	Tiers tués	Phase de vol
10 mars	Ethiopian Airlines	Éthiopie	Ethiopie	Boeing 737 MAX 8	149	8	0	croisière
16 avril	Archipelagos Servicios Aviacion	Chili	Chili	Britten-Norman BN-2B	5	1	0	montée initiale
5 mai	Aeroflot	Russie	Russie	Sukhoi Superjet-100	40	1	0	atterrissage
13 mai	Taquan Air	USA	USA	DHC-3T	1	0	5	croisière
17 oct.	PenAir	USA	USA	SAAB-2000	1	0	0	atterrissage
24 nov.	Busy Bee Congo	RD Congo	RD Congo	Do-228	19	2	6	décollage
24 déc.	Calafia Airlines	Mexique	Mexique	Cessna-208B Grand Caravan	1	1	0	croisière
27 déc.	Bek Air	Kazakhstan	Kazakhstan	Fokker-100	11	1	0	décollage
TOTAL					227	14	11	252

Figure 3.14: Review of fatal passenger accidents on scheduled services worldwide in 2019, aircraft $\geq$ 2.25t

The limited number of fatal accidents that occurred in 2019 does not allow to establish common points on their typology. However, it is necessary to highlight that the accident with the most fatalities is the unfortunately famous case of the Boeing 737 MAX 8, the causes of which have already been identified and resulted in the grounding of the entire fleet of aircraft for months.
The numerical balance presented above makes it possible to calculate overall safety indicators. These are, on the one hand, the ratio between the number of fatal accidents and the overall activity of scheduled air carriers (which can be expressed in number of flights, flight hours or distance flown by aircraft) and, on the other hand, the ratio between the number of passengers killed and overall regular air traffic (expressed in passenger-kilometres flown, PKT). For 2019, this results in the following ratios:

– 0.21 fatal accidents per passenger per million flights;

– 0.15 fatal accidents per passenger per billion km flown;

– 0.027 passenger fatalities per billion PKT.

These indicators are very global and give only a partial view of reality. In particular, they do not take account of fatal accidents on non-scheduled services (estimated at less than 10% of world aviation) and fatal accidents on scheduled services that do not result in passenger deaths. However, they allow an appreciation of the evolution of global aviation safety over several years.
A more relevant picture of the current situation is obtained by putting it into perspective over a very long period of time, as done in the graph below (Figure 3.15).
It can be seen that the continuous improvement in annual rates that had been recorded during the decade 1993-2004 was followed by a long stagnation, for about ten years (from 2004 to 2013). Since 2014, the ratios seemed to be on a downward trend again, a trend that was reversed by the 2018 data, although it seems to be an isolated episode since the 2019 results seem to confirm the same trend, showing a continuous downward average.

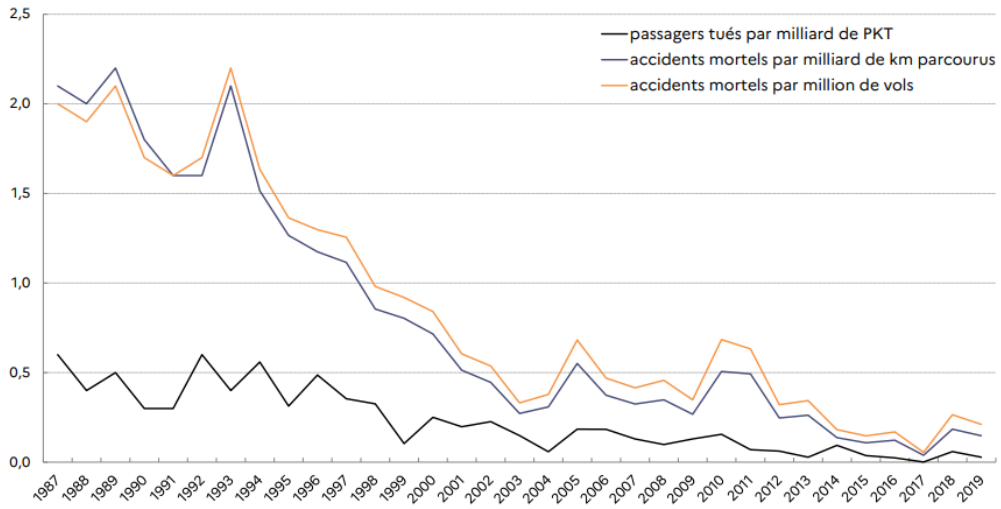

Figure 3.15: Evolution of annual fatal accident rates and passenger deaths on scheduled services since 1987, aircraft $\geq$ 2.25t

This behaviour is most visible by graphing the mortality rate in relation to the number of flights on a logarithmic scale (Figure 3.16). It is possible to observe how representing the linear regression of the available data gives an average decrease curve of 9% on a yearly scale, i.e. a division by a factor of 2 in 7 years, and by a factor of 10 in 24 years.

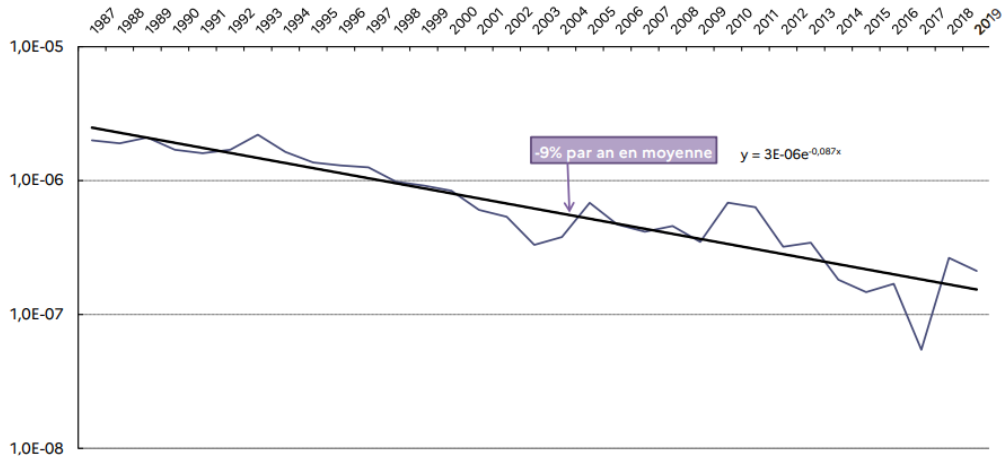

Figure 3.16: Evolution of annual fatal accident rates per flight in scheduled services since 1987, aircraft $\geq$ 2.25 t and logarithmic scale

The French strategic aviation safety objective set by the State's safety programme aims to *"place France among the first European States whose operators are the safest in commercial aviation"*. To this purpose, a comparison with the main European Countries, on a 5-year moving average, has been established and serves as an indicator (see graph in Figure 3.17).
These comparisons were made with the United Kingdom and Germany because of the similarity of their commercial aviation (in terms of development, in particular) to France.
The benchmark was completed by adding the United States, because of the maturity of its commercial aviation sector, and the mean data of the group of EASA Member States, at least for those whose data are available.
For each of these States or groups of States, the number of fatal accidents has been established as involving an airline in the Country or group of Countries. This value has been normalised to the total activity in flight hours in the corresponding State or group of States in order to eliminate the distortion introduced by their different volumes of activity.
Due to the different regulations applied in the respective cases, only aircraft certified to carry 20 or more passengers were considered. This threshold limit is different for US operators since the safety data published by the NTSB refers to aircraft of companies certified 14 CFR 121, aircraft with less than 20 seats.
Helicopters are not included in the comparisons presented. However, this exclusion has no real impact on the analysis because of the particularly small number of helicopters with more than 20 passenger seats operating in public transport worldwide.

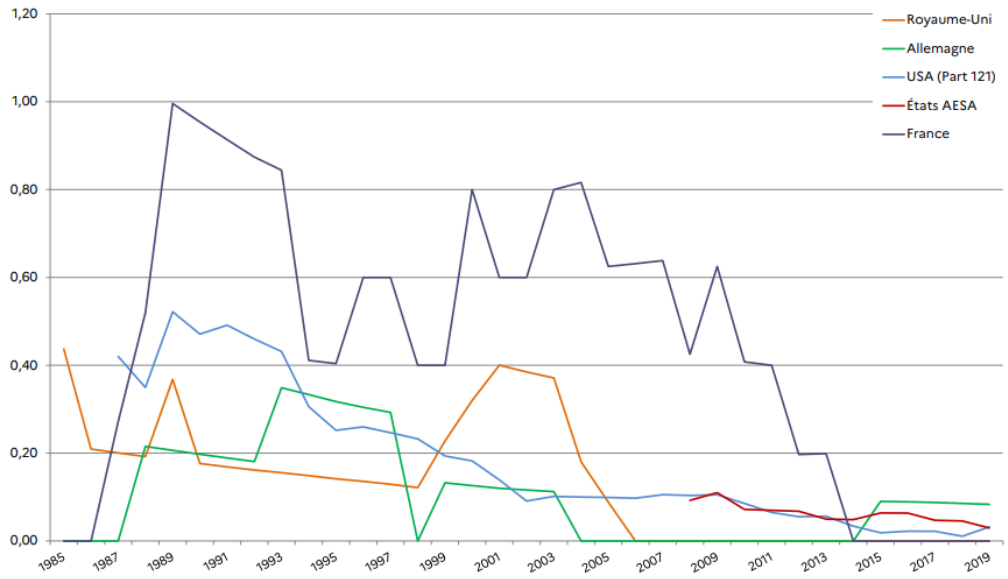

Figure 3.17: Number of fatal accidents involving aircraft $\geq$ 20 passenger seats* (or their all-cargo equivalents) per million commercial flight hours, interstate comparisons and 5-year moving averages

It is important to point out that this limitation to 20 passengers could be misleading, as most of the fatal accident numbers in France in recent years involved aircraft with a capacity of less than 20 passengers, as can be seen from the graph below.

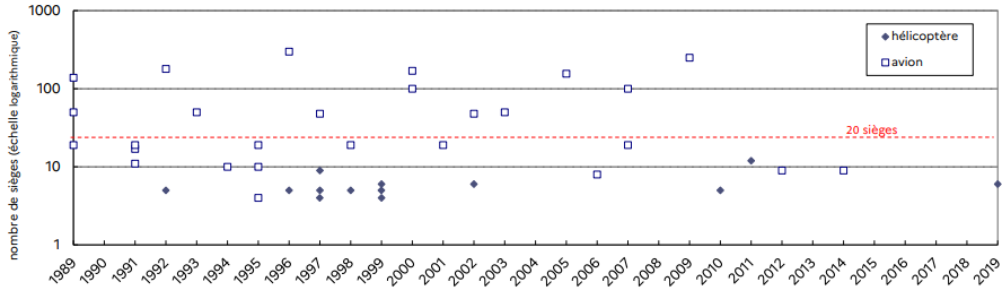

Figure 3.18: Number of aircraft seats involved in fatal accidents for French commercial operators since 1989

At this point the scenario shifts from a global/continental to a national point of view with the second chapter. Today, France is one of the nations with the most air traffic in Europe, the country has more than a hundred companies with an air carrier operating licence. At the end of 2019, 8.795 aircraft registered in France had

a valid certificate of airworthiness, nearly 12% being used in commercial transport and, therefore, almost 90% being operated in the context of general aviation. The latter are mostly aircraft with a maximum certificated take-off weight of less than 5.7 tonnes or even 2.25 tonnes. To these aircraft should be added the approximately 15,805 ultralights that had valid identification cards at the end of 2019 (although the number of ultralights in flight condition is significantly lower).
Ultralights account for two thirds of the fleet of aircraft registered in France, compared to just under a quarter of the total aircraft fleet (see Figure 3.19). Amongst ultralights, paramotors (class 1 ultralights) rank first in terms of number of units (42% of the total), followed by multi-axes (class 3 ultralights, 37%), which predominate over the other classes of ultralights.
In 2019, the Bureau of Enquiry and Analysis for Civil Aviation Safety (BEA) received notification or knowledge of 198 general aviation accidents, a number that is 21% lower than in 2018. Out of this total, 29 accidents were fatal, a 41% decrease from the 49 fatal accidents that occurred in 2018. Accidents in 2019 resulted in the death of 44 people on board or on the ground, 40% less than in 2018, when 73 people were killed.

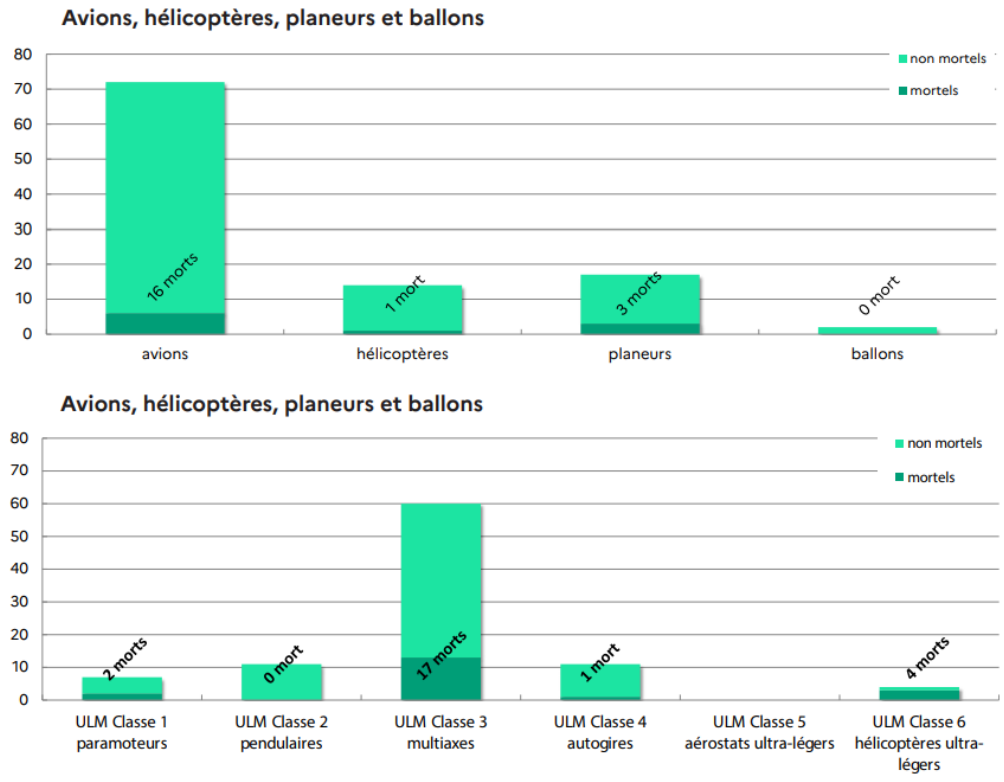

Figure 3.19: Aircraft registered in France: distribution of accidents (fatal and non-fatal) in general aviation in 2019 by category of aircraft involved

These graphs show that in general aviation accidents during the year of interest involving microlights are the most numerous, a situation that can be explained by the prevalence of this category of aircraft in the French general aviation fleet.
The graphs also illustrate the share of fatal accidents in the total number of accidents involving each category of aircraft. It can be seen that class 3 (multi-axis) ultralights had the highest number of fatal accidents during 2019.
The type of accidents occurring in 2019 is consistent with the average type of accidents occurring between 2010 and 2019, illustrated by Figure 3.20, with a prevalence of loss of control (LOC-I) in terms of fatal accidents.
Some of the listed incidents are not investigated by the BEA. In these cases, the attribution of indicators is based on preliminary information, not validated by the BEA. In particular, these are non-fatal accidents involving aircraft listed in Annex I to Regulation (EU) No 1139/2018, [68], (the aircraft listed in this Annex are mainly non-certificated aircraft: ultralights, historic aircraft, etc.).
It needs to be noted that at the time of data collection for this report, most of the 2019 incident surveys had not been completed. As a result, a significant number of indicators had not yet been assigned or fully validated.

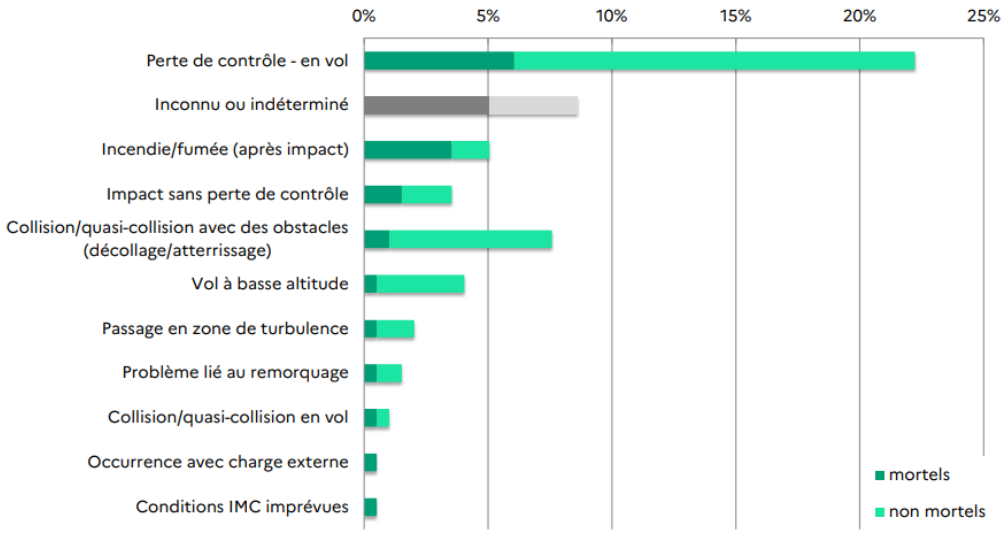

Figure 3.20: Aircraft registered in France: types of general aviation accidents in 2019

Over the last ten years, the annual number of fatal accidents has fluctuated considerably. However, the trend is on a slight downward curve and 2019 is in line with the expected average for the period, after a particularly fatal year in 2018 (73 fatalities, the highest number in the last decade).
The graph below (Figure 3.21) details the types of accidents that have occurred over the last ten years. It has been deliberately limited to the most frequently

observed typological characteristics. It can be seen that the most frequently cited index in fatal accidents is loss of control in flight (LOC-I), significantly ahead of post-impact fire/smoke (F-POST), low altitude flight (LALT) and controlled flight in terrain (CFIT). Other indices are not present in the graph, such as abnormal runway contact (ARC), runway excursions (RE) and loss of ground control (LOC-G). Although they are found in a relatively large number of accidents, in almost all cases they are accidents without fatal consequences for people on board or on the ground.

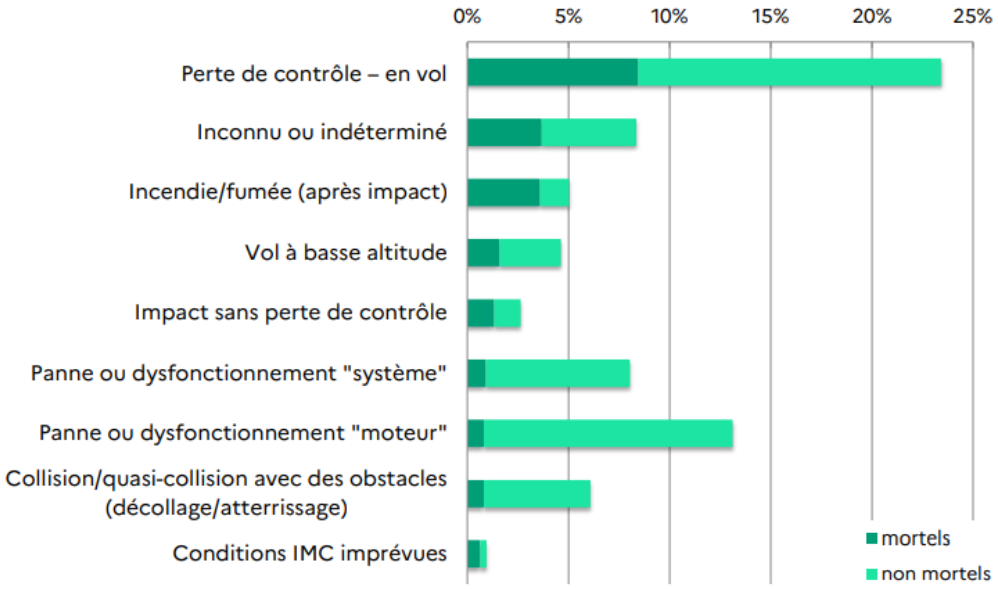

Figure 3.21: Aircraft registered in France: types of general aviation accidents between 2010 and 2019

Another representation is used to describe the French operational scenario over the last decade. This graph was obtained by cross-referencing the severity of events for each indicator with their frequency of occurrence. This makes it possible to locate a particular year, in the case of this SR the year 2019, in terms of the type of accidents compared to the average of the last decade.
From this graph it can be seen that loss of control in flight (LOC-I) and post-impact fires (F-POST) remain the main points of concern, the latter being less frequent but more serious.

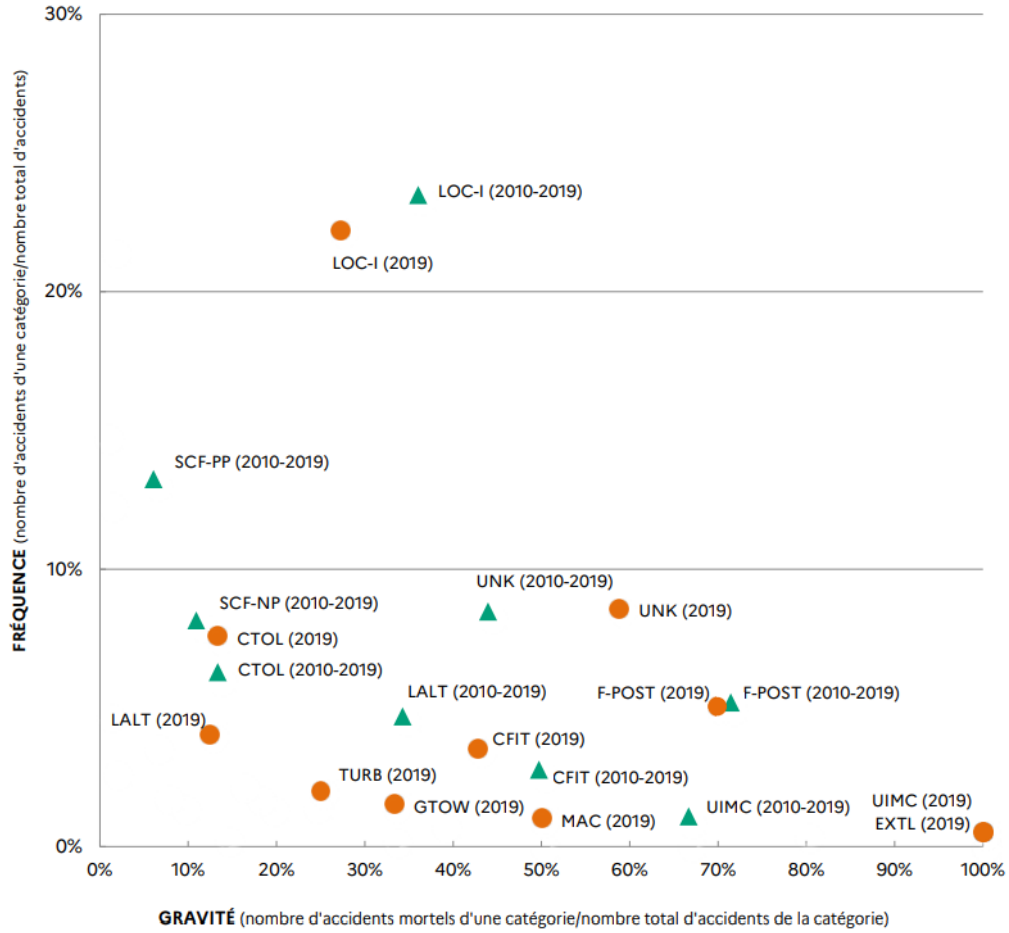

Figure 3.22: Aircraft registered in France: types of general aviation accidents in 2019 compared to the period 2010-2019

In order to fully understand the level of safety of general aviation in France, it is also necessary to take into account accidents occurring in France to aircraft registered abroad. Up to now, only aircraft registered in the country have been taken into account. This is even more important as a large number of aircraft registered abroad (in particular from the United States and Germany) regularly operate in France.
The same analysis was then carried out as before, considering only general aviation incidents involving aircraft registered abroad. In 2019, 28 incidents were reported, including 3 fatalities resulting in 5 casualties.
If all accidents (fatal and non-fatal) are taken into account, the trend over the last decade has fluctuated, with periods of increase following periods of decline around an average of around 30 accidents per year. The year 2019 is slightly below this

amount. If the two aspects (fatal and non-fatal accidents) are considered separately, it can be seen that the trend for the first is in decline, while for the second it is slightly upwards.
The main causes are almost the same for aircraft registered in France as for those registered abroad, loss of control remaining the main factor for fatal accidents. On the other hand, it can be seen that accidents occurring under unexpected IMC conditions are particularly fatal compared to the total number of events in the same category.
By repeating the same analysis of the distribution of the indicators according to their frequency and severity, it can be observed that the most frequent are LOC-I and SCF-NP, while the most severe are UIMC and CFIT.
Both graphs are shown hereafter (Figure 3.23 and Figure 3.24).

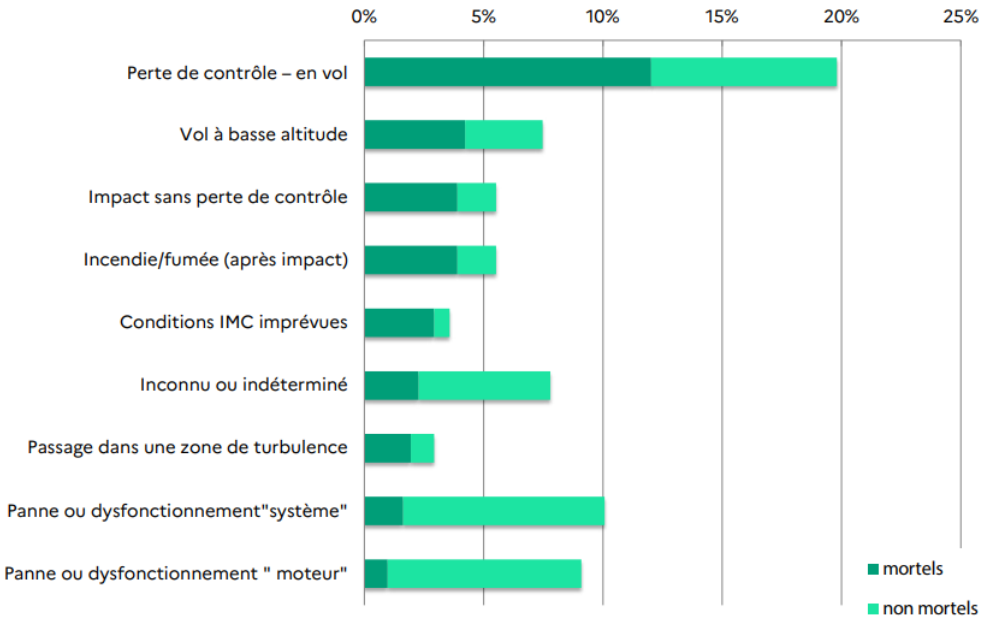

Figure 3.23: Aircraft registered abroad: types of accidents in France between 2010 and 2019 in general aviation

Figure 3.24: Aircraft registered abroad: types of accidents in France in 2019 compared to 2010-2019 in general aviation

The document concludes with an illustration containing all safety event reports brought to the attention of the DGAC from 2001 to 2019.
In 2019, the DGAC's national database was enriched with almost 77500 reports of security events that took place during the same year and were reported by airlines, aerodrome operators, air navigation service providers, ground handling companies, training organisations, etc.
All data received by the French authority are included in the European database of civil aviation safety events - European Central Repository (ECR) - to which France is the largest contributor, demonstrating an excellent accident reporting rate by local operators, compared to other countries.

In conclusion, the French Safety Review already shows fundamental differences from the previous one observed, the Finnish one. Ignoring the structure, where the French case gives greater importance to the situation from a global and continental perspective, the accident analysis also only considers fatal accidents, almost ignoring non-fatal ones.

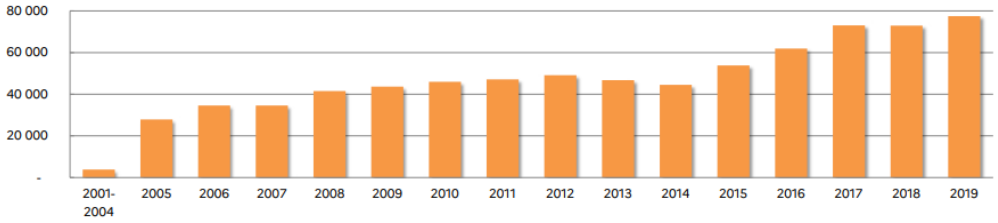

Figure 3.25: Trend of the annual number of event reports notified to the DGCA.

A wide use of SPIs is involved during statistical analyses, and it is curious how they are represented by considering a classification according to their severity as well as according to their frequency of occurrence. The way the data are represented, however, could be a bit misleading. Using the percentage representation on the total number of occurrences might ensure a clearer reading of the indices, but this way the total number of occurrences for each SPI is ignored. This form of representing one's own data, which is different from the other SRs, makes it difficult to perform an initial comparative analysis between one country's document and another.
In the last decade, the SPIs most involved in the occurrences detected by the French authorities are LOC-I, SCF-PP and UNK. With regard to severity, F-POST, UIMC and CFIT are reported, from the highest to the lowest severity.
During the statistical analysis, it is evident that general aviation ultralight aircraft are given greater importance than other types of aircraft, a factor that underlines how the aviation culture of a Country can be different from those in its immediate vicinity.
It is also curious how the French authority divides the cases between aircraft registered in the country and foreign aircraft, which could be a good tool to analyse possible divergences between the two situations, although the occurrences involving aircraft registered in foreign countries are very limited compared to the respective number of aircraft registered in France. It should also be noted that an overall summary analysis is not carried out.

3.3 Italy

The Italian document containing data for 2019 is the Safety Report 2020, [49], published by ENAC in January 2020. The choice adopted by the Italian authorities to publish this document the year following the one taken as reference plays in favour of its completeness, since in this way the publication of the data collection carried out during that time will not be incomplete.

The Italian report is divided into four main parts:

- initial introduction, which consists of a brief explanation of the data collection method as well as a first definition of the ADREP taxonomy terms used in addition to the list of indicators chosen by ENAC;

- accident rate analysis, which represents the trend of the number of accidents per million departures for commercial flights of aircrafts with MTOW> 5700 Kg of Europe and Italy compared to the worldwide situation from 2008 to 2019;

- study of the trend regarding the number of occurrences subdivided by the indicated SPIs;

- conclusions and final considerations.

In Italy, data on mandatory reports are collected through the eE-MOR platform, which has been developed by the Italian civil authority to meet the requirements imposed by EASA and the European Union. This system is based on the European Commission's Eccairs 5 software and provides a web interface that allows direct data entry, ensuring high quality and standardisation. In addition, beyond the mandatory reports, it allows the collection of reports on events related to drones and dangerous goods.

Regarding the first statistical analysis in the document, only accidents are covered. It can be seen from the graphs below that the worldwide data from 2008 to 2019 are slightly in decline, from around 5 accidents per million departures in 2008 to almost 3 in 2019. The trend of the European data follows for the main part the world trend, except for some peaks in the time interval considered. In particular, there is a peak in 2011 when the number of accidents in Europe exceeded 5 per million departures, in 2012 when it was about 4.5 (more than one point above the world average) and in 2019 when it stood at 3.54 (about 0.5 higher than the globe average). Considering only the Italian case, the data seems to be spread within the period of interest. This may be justified due to the larger dataset available in the ICAO database compared to the actual number of accidents in Italy, which is a more limited number. Although the trend of the Italian data seems to fluctuate over the years, an average trend can be identified that is basically equivalent to the world one.
Only commercial flights of aircrafts with MTOW greater than 5700 kg are considered in this analysis.

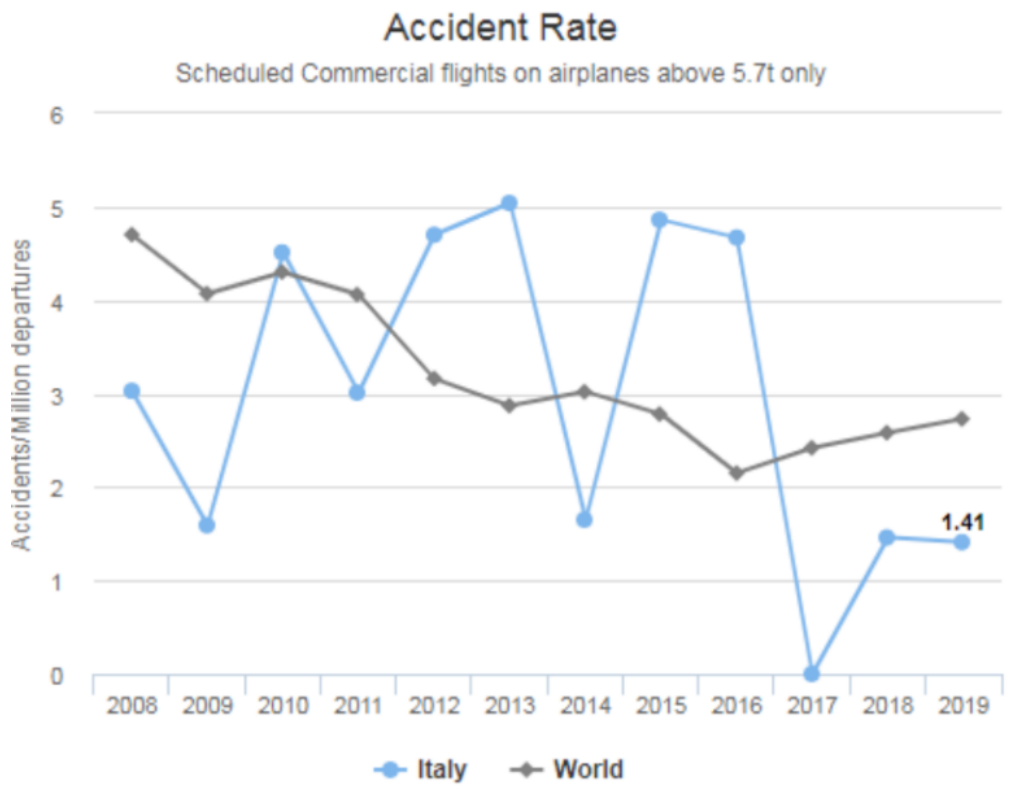

Figure 3.26: Analysis of accident rate per million departures occurring from 2008 to 2019 in Italy compared to the worldwide scenario.

This analysis is followed by one based on the SPIs adopted by the Italian authorities. SPIs have been grouped into two main categories:

- operational SPIs, which regard occurrences that are precursors to undesired events, in this case accidents or serious incidents. They have been accurately chosen by ENAC taking into account the most relevant domains of civil aviation (aerodrome, air traffic control, airworthiness, operations and UAS) and their data are collected from the reports on the Italian eE-MOR system;
- systemic SPI, which concern the most typical processes of the Civil Aviation Authority. They provide an instrument to measure the effectiveness of the actions taken by ENAC to ensure a high level of safety of aviation operations.

Only operational SPIs will be considered further on, as they are the real point of interest for this study and the most common element with the other reports previously analysed. There are 13 in total: RE, RI, LOC-I, TCAS Resolution Advisories, TAWS Activations, RAMP, GCOL, F-NI, LASER, UPA, SMI, ATM

failure and APR interferences. Three different graphs are shown for each index: the first relates to the number of occurrences per year, the second concerns the rate of occurrence per 10,000 movements per year and the last regards the growth of national air traffic over the period of interest.
As regards Runway Excursions, it can be observed that the trend of relative occurrences has not followed the increase in movements that occurred in the five-year period considered, from 2015 to 2019. Movements through Italian airspace went from 1.54Mln in 2015 to 1.84Mln in 2019, which corresponds to a 19.5% increase in air traffic. In terms of occurrences related to RE, the trend shows a slightly upward tendency. In 2015, there were 12 occurrences, with a slightly downward trajectory in the following year (11 in 2016), but the performance changed shortly thereafter to an upward trend, from 16 occurrences in 2017 to 20 in 2018 and then 18 in 2019.

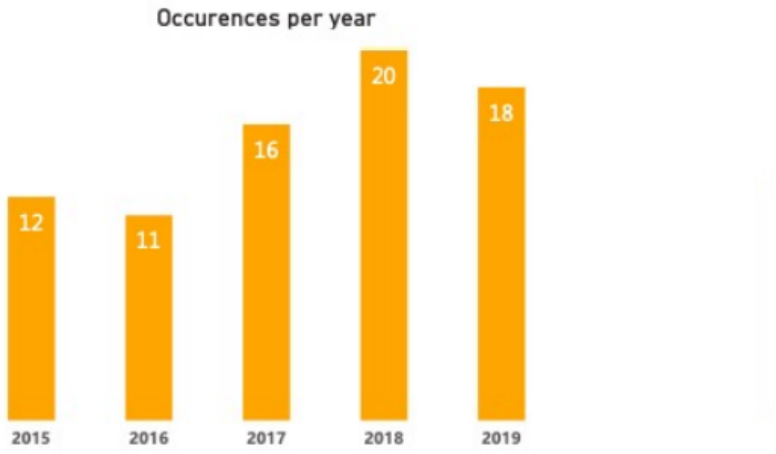

Figure 3.27: Trend of RE occurrences within Italian airspace from 2015 to 2019.

Runway Incursions have a similar trend as RE, which can be explained by the significant increase of air traffic. Concerning RI, a 19.5% movement increase in 5 years corresponds to a 134% occurrence increase in the same period. In 2015, there were 80 events in total, followed by a decrease in the number of cases (72 in 2016), before a sharp upward trend. Between 2016 and 2017 there was a 75% rise (from 72 to 127 events) and a further 36% increase in 2018 (180), before a slight stabilisation in the following year (187 in 2019, +4%).
Observing the rates, it can be seen that the indicator fluctuated from 0.44 to 1.05 over the five-year period of interest. A negative trend is present between 2018 and 2019 (-4%, from 1.05 to 1.01), which could be mistakenly observed from the graph of the number of occurrences per year. This means that the performance of the national authorities has slightly improved in the last two years, although there

have been more occurrences of RI (180 to 187), these are due to the increased flow of movements and not to a safety downgrade.

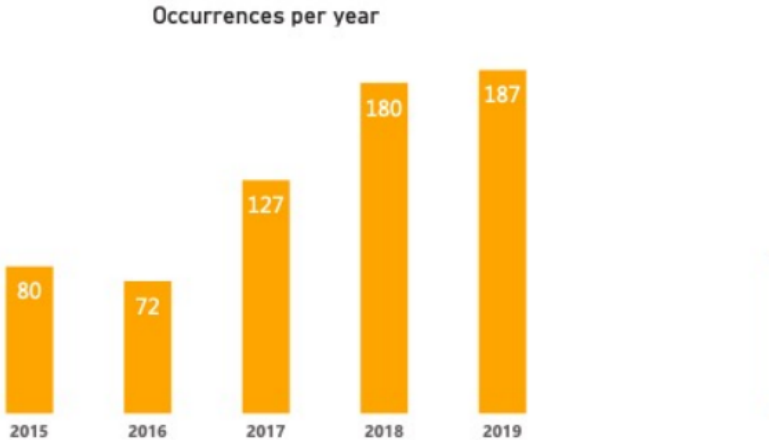

Figure 3.28: Trend of RI occurrences within Italian airspace from 2015 to 2019.

The index concerning the Loss of Aircraft Control In-flight shows a constant decreasing trend from 2015 to 2018, the cases went from 28 to 22 corresponding to a decrease of -21%. This was before a rapid growth of 105% (45 events) in the number of occurrences recorded in 2019. The indicator concerning LOC-I is one of the few operational SPIs where the number of flights is considered instead of movements to determine its rate. The data is also expressed by rates of occurrences per 10,000 flights, by the way there is the same significant increase in cases during 2019. Investigations have been undertaken by the Italian authorities to find out the reason for the reverse trend and the important growth of cases during the last year.

TCAS Resolution Advisories are expressed according to the number of occurrences and the rate per 10,000 flights. In 2015 and 2016 the number of reports was negligible as the eE-MOR system did not include some data. Since 2017 all records concerning this phenomenon have been included, which is why there has been a drastic change between 2016-2017. In 2017, 168 events occurred, with a slight increase in the following two years (203 and 204). When analysing the rate of occurrence per 10,000 flights, it can be seen that over the last three years the data has fluctuated from 0.94 to 1.08, with a slight decrease in 2019 compared to the previous year. Due to the limited availability of database it is not possible to identify a clear statistical trend.

Figure 3.29: Trend of LOC-I occurrences within Italian airspace from 2015 to 2019.

Figure 3.30: Trend of TCAS Resolution Advisories occurrences within Italian airspace from 2015 to 2019.

The TAWS system is necessary to choose an effective action to prevent a CFIT event, it provides the crew with useful information and warnings to reveal a potentially dangerous situation where the aircraft has approached the ground perilously. The Italian authorities collect data on the activations of this system. The events are represented by the number of occurrences and by the number of activations per 10,000 flights.
Seeing the graph below, it is possible to identify a markedly decreasing trend, events have fallen from 25 verified in 2016 to 6 in 2019. This represents a reduction of -77%. The same tendency can be identified in the graph of the number of occurrences per 10,000 flights, which indicates that this behaviour is linked to the

actions taken by ENAC in recent years.

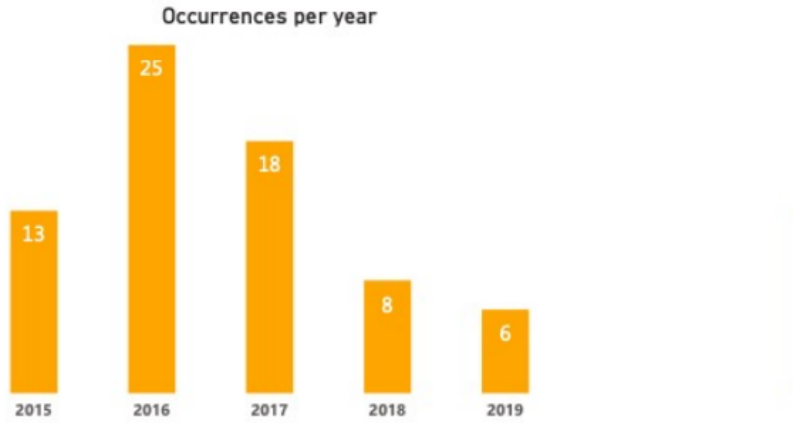

Figure 3.31: Trend of TAWS Activations occurrences within Italian airspace from 2015 to 2019.

Ramp events concern all those actions where a collision has occurred during typical airport operations, such as boarding, loading, servicing and deplaning the aircraft. From the graph below covering the last five years, it is possible to identify an increasing trend in occurrences for this index. From 28 events in 2015, it rose to 66 in 2016, then to 78 and later to 93 and 100 in 2018-2019, respectively. The marked increase in movements within Italian airspace definitely did not contribute. The number of occurrences per 10,000 movements graph shows how the data fluctuates between 0.18 and 0.54, with a clearly upward trend, although it has stabilised in the last year.
There is also an analysis of the 10 most important national airports by movements, which shows that some are actually below the annual standard deviation, while others are above it. This makes it possible to identify which areas are most affected by this phenomenon and to plan future actions.

The SPI related to collision while taxiing to or from a runway in use follows an increasing trend within the time period of interest. From the graph below it can be observed that in Italy there were 22 occurrences in 2015, while in 2019 there were 104 events. Analysing the graph relative to the rate per 10,000 movements, it is possible to note that this trend is confirmed, increasing from 0.14 in 2015 to 0.56 in 2019.
Given the constant trend of this index, it is possible to foresee a target for the following year and a series of mitigation measures in order to lower its value.

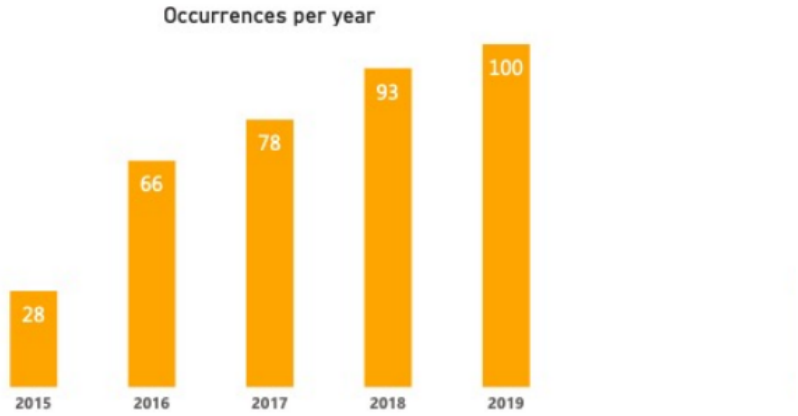

Figure 3.32: Trend of RAMP occurrences within Italian airspace from 2015 to 2019.

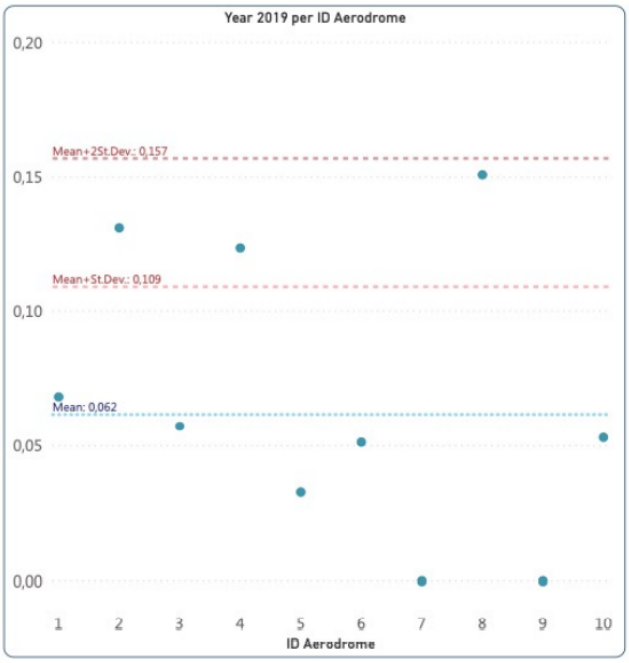

Figure 3.33: Study of the 10 most important Italian airports by movements and respective values by RAMP occurrence rate in 2019.

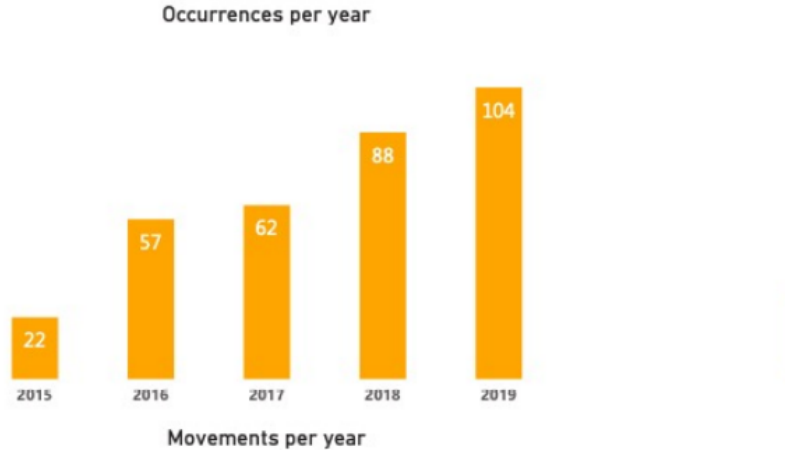

Figure 3.34: Trend of GCOL occurrences within Italian airspace from 2015 to 2019.

The F-NI index shows a fluctuating behaviour from 2015 to 2019. It is not possible to identify a clear trend, the cases increase from 34 verified in 2015 to 49 in 2019, going through 23 in 2016, 33 in 2017 and 30 in 2018. The rate per 10,000 flights also shows a fluctuating tendency, within the time period of interest the values fluctuate between 0.133 and 0.25. It is not possible to identify a clear trend, but the values seem to remain stable within the fluctuation range, although the trend in the number of flights has been steadily increasing since 2016.

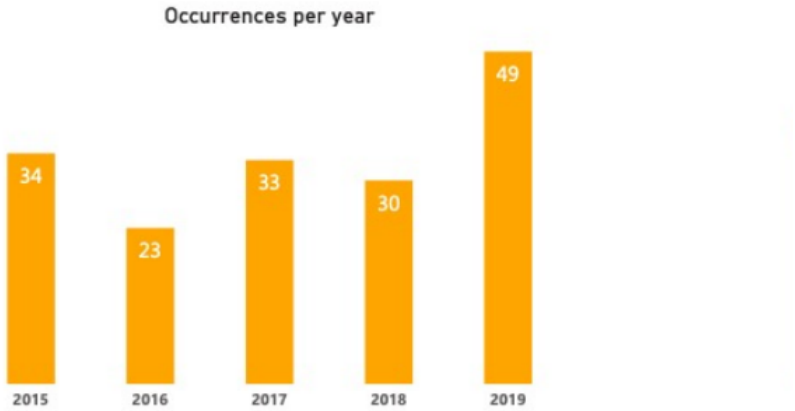

Figure 3.35: Trend of F-NI occurrences within Italian airspace from 2015 to 2019.

The phenomenon of laser interference is becoming increasingly important in civil aviation. In Italy there were 162 occurrences in 2015 and 109 in 2016, a decrease of -34%. Since that year there has been a reversal of the trend, cases have started to

increase: 144 (+32% compared to the previous year) occurrences in 2017 and 289 in 2018 (+101%). In 2019, there was a slight stabilisation with 294 cases (+2%).
Analysing the data on the rate of occurrences per movement per year, it can be seen that the data fluctuated from 1.05 to 1.68 events every 10.000 movements in the period from 2015 to 2018 before dropping to 1.60 in 2019, which is still above the average of 1.173 for the five-year period.
Laser beam attacks depend mainly on geographical location, this phenomenon is closely linked to airport areas. In 2019, 3 airports can be identified as responsible for most of the reported events: Naples, Palermo and Milan.

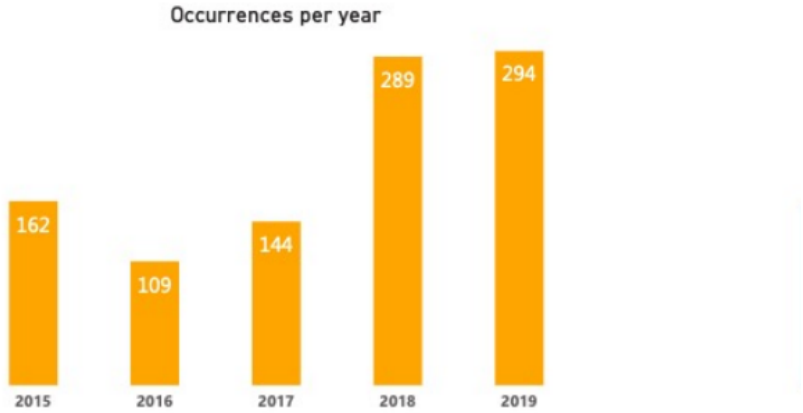

Figure 3.36: Trend of Laser Beam Interferences occurrences within Italian airspace from 2015 to 2019.

The UPA index concerns the number of airspace violations by an aircraft. A notification occurs whenever an aircraft enters a given ATC-controlled area without having obtained an authorisation.
It can be seen from the graph below that there is no data for 2015-2016, as the e-EMOR system did not collect this type of information. The reason for this is that during the first two years of the time period of interest, the Air Navigation Service Providers (ANSPs) did not transmit the collected data to ENAC's eE-MOR system. This phenomenon concerns the SPIs related to: TCAS Resolution Advisories, UPA, SMI and ATM failure.
The first data available is for 2017 where 284 occurrences were recorded. In 2019 these events rose to 379 (+33.5%), before decreasing slightly in the following year to 358 cases (-5.5%).
Given the limited availability of data, it is not possible to identify a clear trend for this indicator. In addition, it can be noted that this indices is the first one without a graphical representation of its normalised trend; only the actual number of occurrences per year is present.

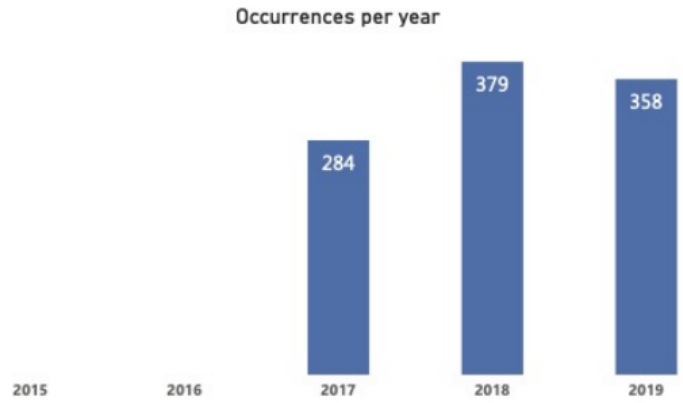

Figure 3.37: Trend of UPA occurrences within Italian airspace from 2015 to 2019.

Similarly to the previous index, the separation minimum infringements indicator has no data for the first two years of the period under consideration (2015 and 2016).The trend is similar to the previous one, although the number of registered cases is slightly lower. In 2017, 262 occurrences were recorded, while there was a sharp increase during the following year (333 occurrences, +27%), before a decrease in 2020 when the index settled at 283 cases (-15%). As before, a clear trend of the indicator can not be determined, so it is not possible to make a forecast for the following year or to establish a precise target to be reached.

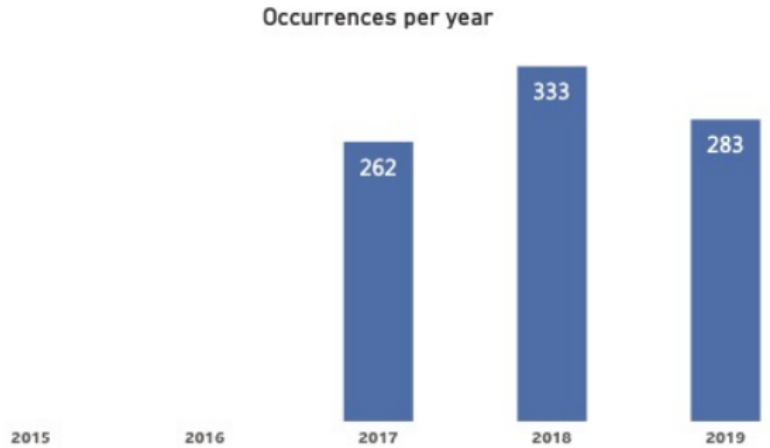

Figure 3.38: Trend of SMI occurrences within Italian airspace from 2015 to 2019.

The index concerning ATM failures indicates occurrences where there have been serious technical faults in the safe provision of air traffic services. These can affect both Air Traffic Management (ATM) and Air Traffic Control (ATC) procedures

and activities.
Even for this indicator the notification numbers during 2015-2016 are negligible, it is impossible to determine the value from the graph shown in Figure 3.39. Therefore, neglecting the first years, it can be observed that the trend of this index is strongly upward. In 2017, there were 30 verified cases, while in 2018 they increased to 69 and reached 166 recorded occurrences in 2019. This trend corresponds to an increment in cases of +130% between 2017 and 2018 and +140% between 2018 and 2019. According to the Italian authorities, this increase is probably due to an improvement in the national reporting culture rather than an increase in the number of incidents.

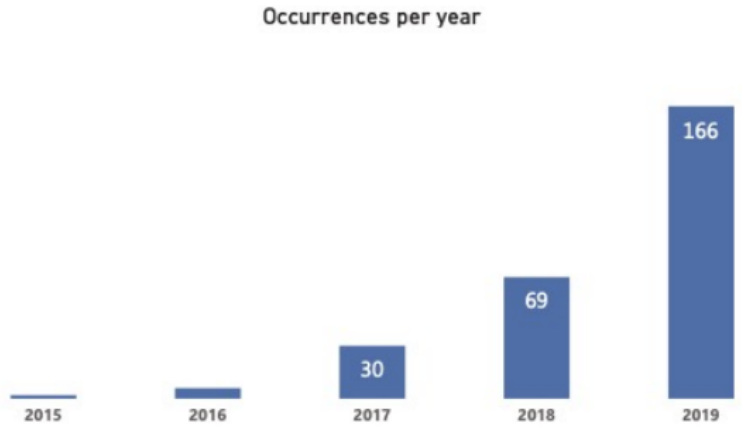

Figure 3.39: Trend of ATM failures occurrences within Italian airspace from 2015 to 2019.

The last SPI illustrated within the Italian document refers to the iteration between unmanned and manned aircraft. Drones are becoming increasingly important and more and more popular within the aviation environment. It is therefore of crucial importance to introduce more effective controls and laws so that iteration between a remotely piloted aircraft and an aeroplane does not occur.
The most difficult phases of flight where such iterations can be most frequent are take-off and landing, where an aircraft is at lower speeds and altitudes, often in or near population areas.
Italian authorities monitor these occurrences through a specific index. In 2015 there were only 12 occurrences where a possible interference of a drone with a manned aircraft was reported, since then the trend has been steadily increasing. In 2016 there were 14 cases, which is a slight increase, but in 2017 these events more than tripled (45), before reaching 62 and 103 occurrences in 2018 and 2019, respectively. This trend is due to the increased diffusion and use of remotely piloted aircraft, but more importantly also to an improved reporting culture.

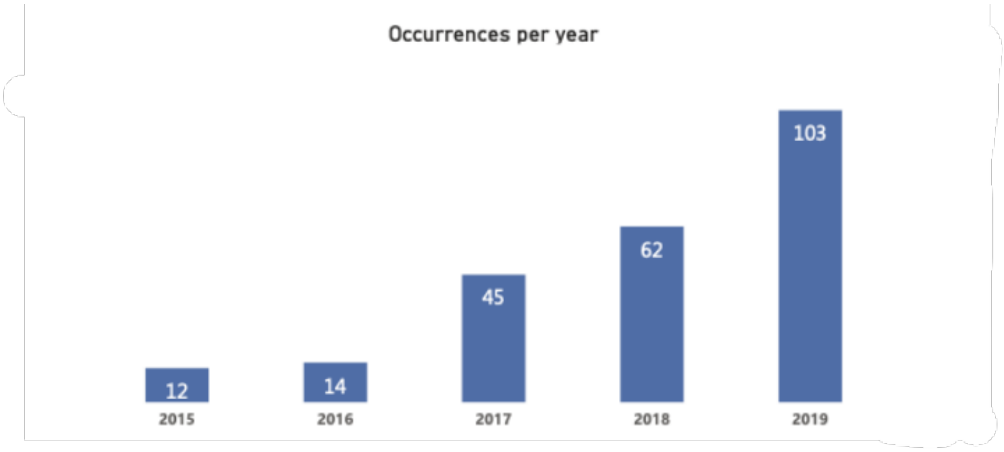

Figure 3.40: Trend of APR Interferences occurrences within Italian airspace from 2015 to 2019.

In conclusion, the analysis carried out by the Italian authority and presented with the Safety Review illustrated above satisfies the requirements of the European agency.
It is necessary to remember that the study of the national safety scenario is not the ultimate aim of this document, but it is important to define a series of targets for each indicator in order to assess the real effectiveness of the actions illustrated in the national Safety Plan. From the above graphs it can be seen that Italy is on the right track, since for some indicators such as RAMP events and GCOL it is possible to identify a trend, despite the upward trend. From this it will be possible in the future to make forecasts and define targets to be met, so as to mitigate the evolution of the relative indicators and improve safety from a national point of view. On the other hand, for some indicators there are not so mature data that allow such an activity, it will be necessary to wait for another data collection in order to evaluate its feasibility.
It is important to underline that Italy is an emerging country from the point of view of safety monitoring. ENAC's continued commitment can be seen in the exponential growth in the number of reports received. They have more than doubled from 2016 to 2017 - going from 4563 to 9200 - and have since then assumed a continuous upward trend until stabilising at 10095 in 2019. This effort can also be seen in the Italian authority's ongoing commitment to making its own work more accessible and easier to consult, and the adoption of an entirely dynamic and digital system such as the new Safety Portal - following the example of other countries - is a clear demonstration of that.

3.4 Ireland

The Irish Safety Review for the year 2019, [20], is prepared by the National Aviation Authority and published on its website in a compilation with all other Annual Safety Performance Reviews, as SRs are referred to.
This document is divided into five main sections. The first deals with a brief introductory analysis of the structure of the document and how the national regulatory framework has been organised, while the other four focus on different scenarios in Irish aviation: the Irish commercial fixed wing sector, the commercial helicopter sector, the air navigation services and aerodromes sector and the general aviation sector in Ireland.
Each of these chapters is written in a rather similar way. First there is a brief introduction, followed by an analysis of accidents and serious incidents, then occurrences and finally safety issues. In addition there may be parts exclusive to that particular topic which are only covered in that sector.
The Irish fixed-wing Commercial Air Transport (CAT) industry consists of two types of commercial organisations:

- operators holding an Irish Air Operators Certificate (AOC) issued by the IAA (there are currently 13);

- operators using an aircraft registered in Ireland on an AOC issued by a foreign State under Article 83 bis of the Chicago Convention, hereinafter referred to as the Irish Leased Fleet.

Between the Irish leased fleet and Irish AOC holders, there were 791 aircraft on the Irish Aircraft Register that were engaged in CAT operations at 31 December 2019. Over the past five years, aircraft operated by Irish AOC holders or on the Irish leased fleet have been involved in 14 accidents (1 in 2019) and 72 serious accidents (10 in 2019), as summarised in the image below (Figure 3.41).
The fatal accident included in this table occurred in October 2015 and involved a foreign AOC holder operating an Irish registered aircraft, which tragically resulted in the loss of 224 lives. It remains under investigation by the Egyptian Ministry of Civil Aviation who have advised that they are investigating suspected criminal activity as the cause of this incident.
There were no fatal accidents and only one non-fatal accident in 2019. The non-fatal incident involved a passenger who was injured while disembarking from a flight.
There were 10 serious incidents during the year, bringing the total to 11. These numbers are significantly lower than in the previous five years and consequently below the expected average during these five years.

Year	No. on Irish aircraft register	Accidents			Serious incidents
		Non-fatal	Fatal	Total	
2015	740	3	1	4	20
2016	793	2	0	2	17
2017	881	5	0	5	11
2018	884	3	0	3	14
2019	791	1	0	1	10
Total	-	14	1	15	72

Figure 3.41: Incidents and serious accidents involving aircraft registered in Ireland engaging in CAT from 2015 to 2019.

The indicators assigned to accidents and serious incidents that have occurred in the last five years are summarised below and give an idea of the type of events involved.

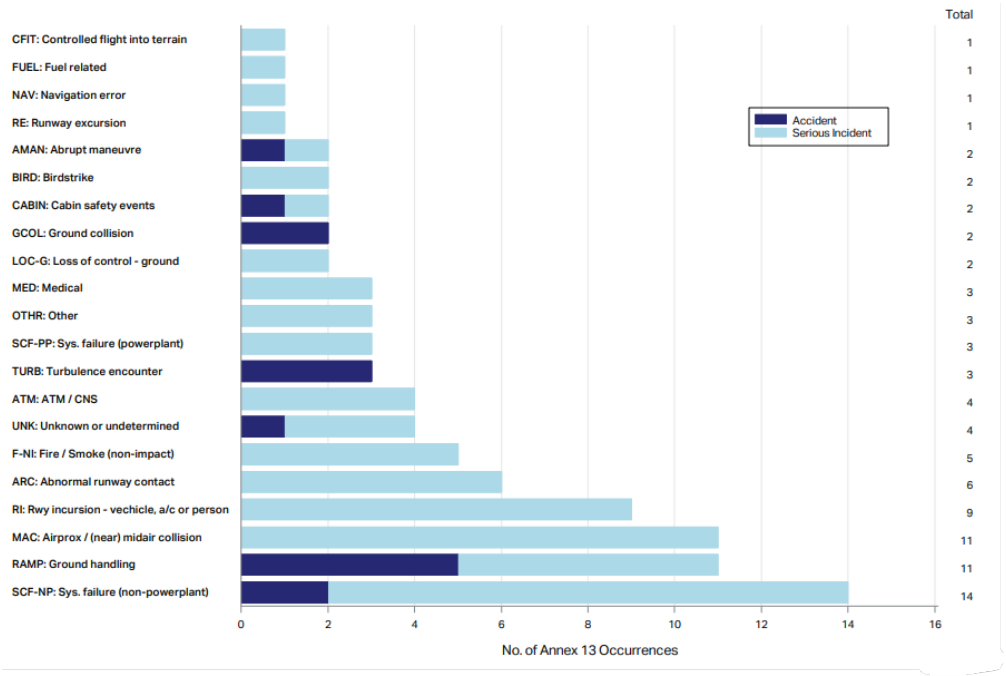

Figure 3.42: Indicators assigned by the investigating SIA to the occurrences.

It is highlighted that the probability of being involved in a flight operated by an Irish AOC holder that is involved in a safety event remains very low. Irish AOC holders operated over 1.100.000 flights in 2019 and reported almost 10.000 events during this period. Therefore, over 99% of these flights passed without any safety event requiring reporting to the IAA and over 99.99% of these flights passed without being involved in an accident or serious incident. Zero commercial flights resulted in fatal accidents in 2019.
The IAA groups occurrences using the same common taxonomy as that used by the Air Accident Investigation Unit (AAIU), however in the case of mandatory reported occurrences the analysis is concerned with occurrences that could be considered as precursors to accidents and/or serious incidents.
A breakdown of the main occurrences submitted by Irish AOC holders involved in CAT operations by occurrence category and risk classification band is shown in Figure 3.43 below.

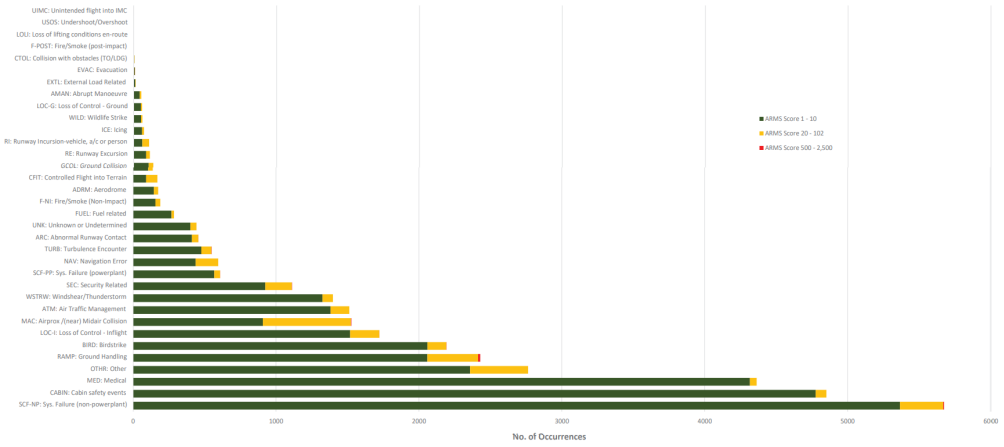

Figure 3.43: Breakdown of the main occurrences submitted by Irish AOC holders involved in CAT operations.

In addition to analysing the categories of events, the IAA analyses the main types of events behind these figures. This analysis allows a deeper understanding of the actions involved that led to the event being reported. Figure 3.44 provides a list of the main event types reported to the IAA by the CAT aircraft sector.

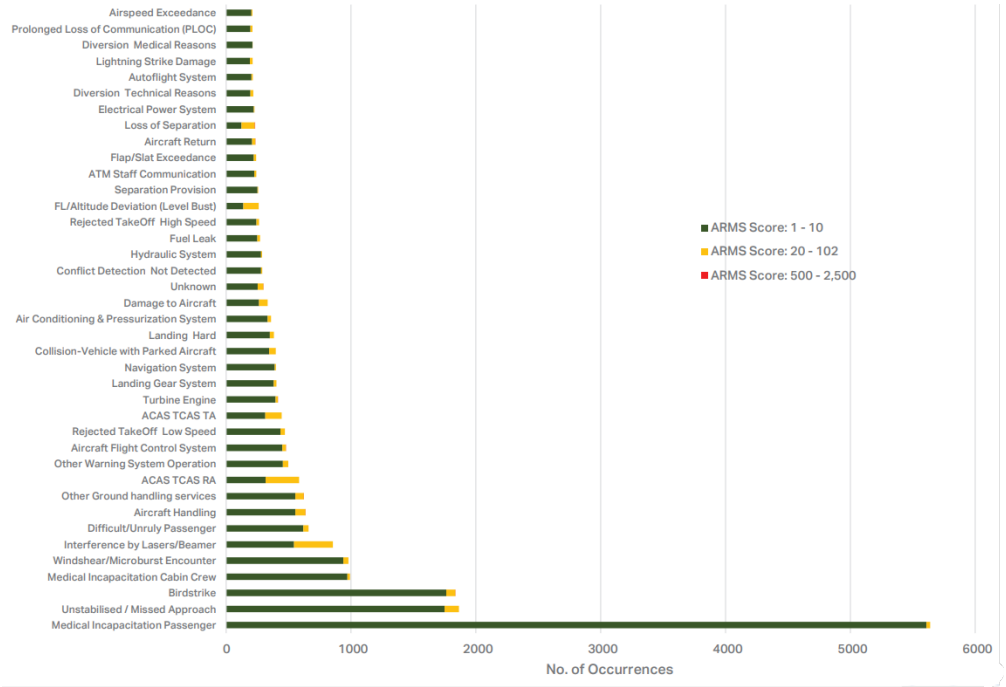

Figure 3.44: Breakdown of the main event types reported to the IAA by the CAT aircraft sector.

The IAA also provides an opportunity for members of the public to report safety concerns outside the regulatory framework. A site is used by aircraft passengers and concerned citizens to report and provides a very valuable source of information to the IAA. Although these reports are outside the regulatory environment, the IAA applies the same protections of reporters, confidentiality of information and appropriate use of data as contained in the incident reporting regulations. These reports are analysed to identify safety issues and are followed up with the organisations involved. The following image provides a breakdown of voluntary reports submitted to the IAA between 2016 and 2019, relating to Irish AOC holders.

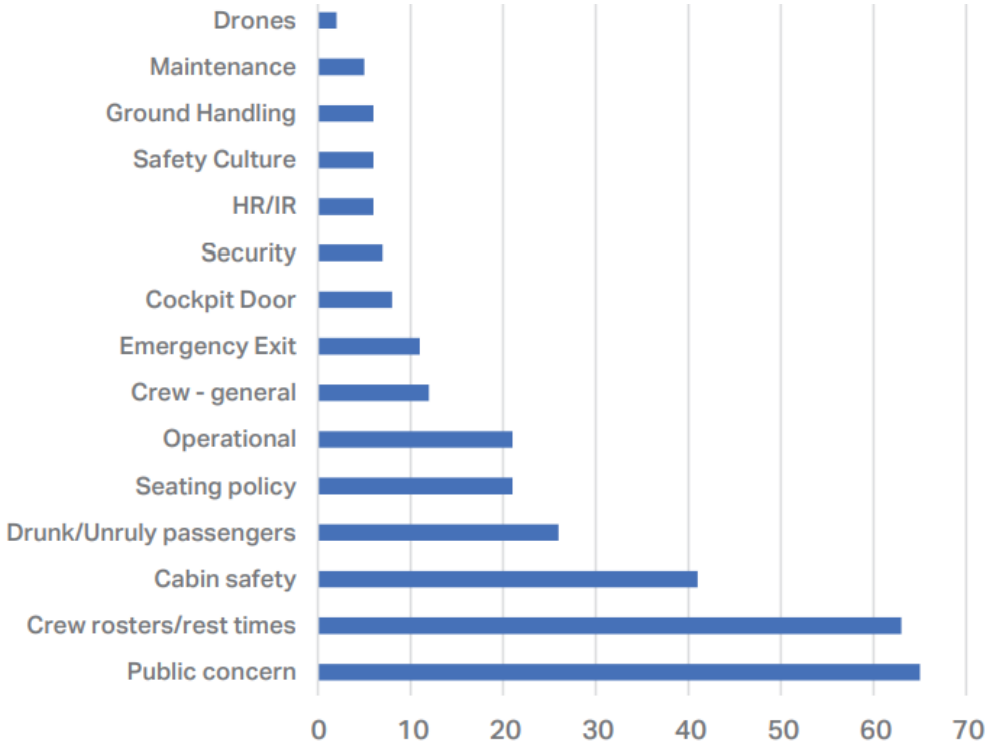

Figure 3.45: Breakdown of voluntary reports submitted to the IAA between 2016 and 2019, relating to Irish AOC holders.

The section on Safety Issues provides a summary of the main safety issues arising from the analysis of previous safety performance statistics for CAT aircraft operations. The first subsection focuses on the major safety areas identified worldwide as the main causes of fatal aviation accidents, and the second subsection focuses on other safety areas where the probability of fatal accidents is low, but where high severity events could lead to costly damage to aircraft or serious inconvenience to aircraft occupants.
ICAO and EASA analysis of global aviation safety data identified the following categories: controlled flight over terrain (CFIT), loss of control in flight (LOC-I), mid-air collision (MAC) and runway incursions (RI) and excursions (RE) as the main contributors to high fatality accidents in commercial flight operations. CFIT, MAC and LOC-I accidents often have catastrophic results with very few, if any, survivors. Although statistically very few runway incursions result in collisions, there is a high risk of fatality associated with these events. Runway excursions remain predominant in terms of number of occurrences with the majority of runway excursions survivable, however the fatality risk remains significant.
Figure 3.41 shows that over the last five years there have been no fatal accidents

in these categories involving Irish AOC holders and Irish leased fleet operators. However, during this period there have been 22 serious incidents in these key safety areas; 11 classified as MAC, 9 classified as RI and 1 classified as RE and CFIT. Although there were no incidents classified as LOC-I, it is noted that there were 3 incidents due to turbulence encounters that caused the aircraft to become upset during flight.

For its part, Figure 3.42 illustrates that reports of precursor events classified as MAC and LOC-I are in the top 10 most reported event categories over the last four years. This highlights operators' awareness of these key safety risk areas and the maturation of a good reporting culture. Analysis of these reports shows firstly that the majority have been classified as low risk and secondly allows the identification of weaknesses and trends in the industry that can be used to inform appropriate mitigation measures. The CFIT category has proportionally far fewer related events and most of these relate to the activation of TAWS alerts, demonstrating the effectiveness of this technological mitigation. Similarly, there are fewer reports of CAT aircraft operators in the RI and RE high-risk event categories. In addition to the insight gained from their analysis as a sector, they highlight the need to address safety risks from an interdisciplinary perspective, such as flight operations, aerodrome operators and air navigation service providers, in order to maximise the effectiveness of safety barriers.

Figure 3.43 provides more information on the events that led to reports of occurrences in these categories and some of the Public Concern issues shown in Figure 3.44 reflect passenger anxiety about perceived events in these areas (e.g. aircraft upset, proximity of other traffic, hard landing).

The detailed analysis of these occurrences, together with the follow-up information provided by the reporting organisation, allows the Irish authority to issue a set of safety issues for each problem area in order to improve its efforts in the near future and reduce the number of occurrences where it is unacceptable.

Concerning commercial helicopters, which is the focus of section C of the Safety Review, no accidents (fatal or non-fatal) or serious incidents were reported during 2019.

The last fatal accident was in 2017, while the last serious incident was in 2015. It is also worth highlighting the lower volume of domestic traffic for this category of aircraft: in 2015, 10 helicopters were registered for commercial use, while they doubled (20) in 2019.

The IAA groups helicopter occurrences using the same taxonomy that is also common with commercial fixed-wing aircraft. The main categories reported were System Failure or Malfunction and Other. The latter category reflects the difficult environment in which helicopters operate, which can affect on-board systems. Most of these events were low risk, indicating minor failures or redundant system failures that had little effect on operations. The high use of the Other category in the

helicopter sector reflects the fact that the ADREP taxonomy does not fully account for specialised low-level commercial helicopter operations.
As done for fixed-wing aircraft, a breakdown of the top events submitted by Irish helicopter AOC holders between 2016 and 2019 (Figure 3.46) and the top events that provide more information on the events behind these categories are shown below (Figure3.47)

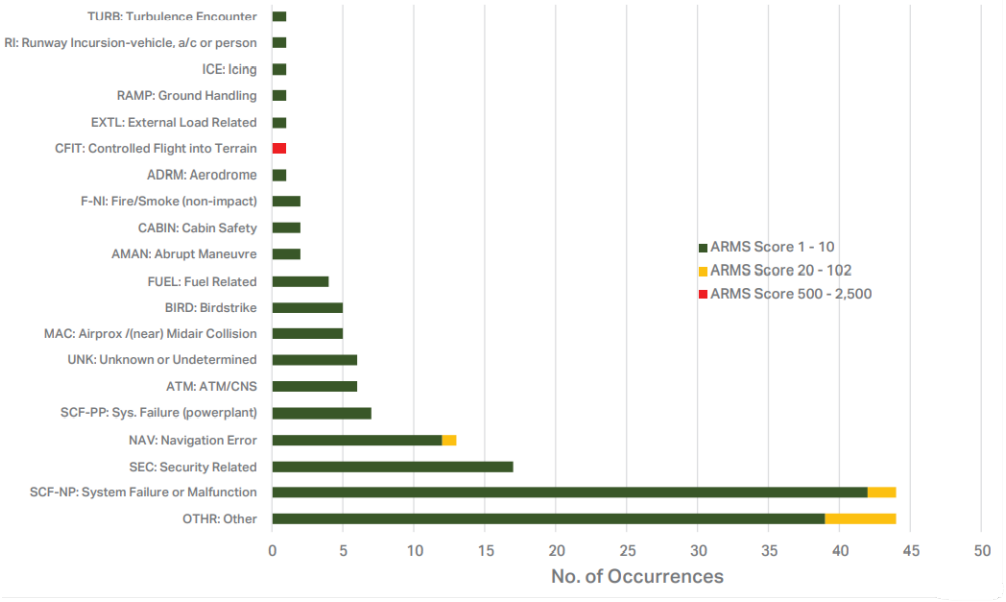

Figure 3.46: Breakdown of the main occurrences submitted by Irish AOC holders involved in commercial and declared helicopter operations.

Due to the relatively low level of activity of commercial and declared operations in Ireland and, consequently, the relatively low levels of reported safety occurrences, it is difficult to identify the main areas of risk from the analysis of Irish safety information alone. However, EASA's analysis of the safety performance of this sector across the EU (including Ireland) may support the efforts of the IAA in this regard. EASA has identified the main areas of risk based on its analysis of helicopter accidents and serious incidents in this sector across Europe as aircraft upset and collision with obstacles or terrain.
There has been one fatal accident in Ireland in the last five years involving collision with terrain. Figure 3.46 shows that there has been one accident related to aircraft upset (i.e. a abrupt manoeuvre), but no category event related to loss of control in flight.

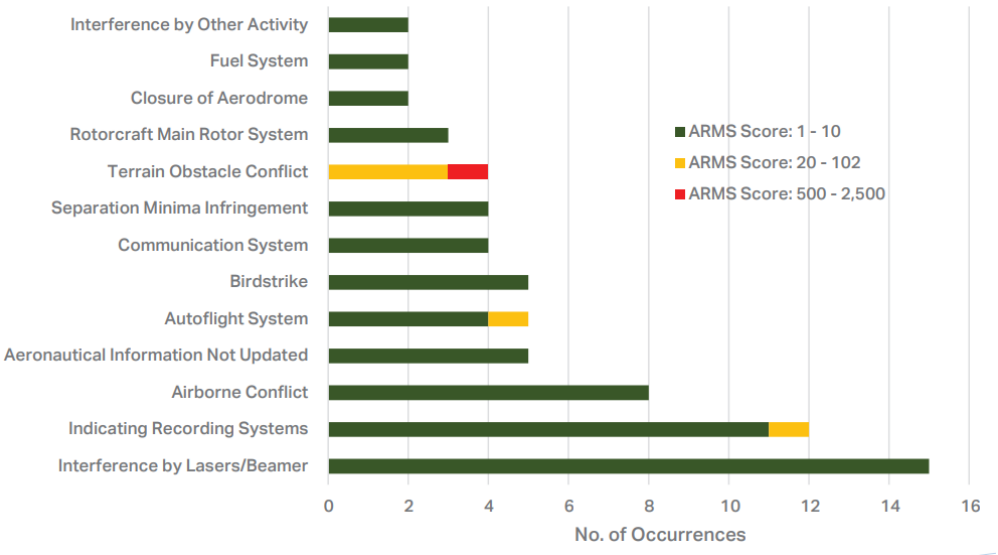

Figure 3.47: Breakdown of the main event types reported to the IAA by commercial and declared helicopter operators.

Figure 3.46 gives more insight into the events that led to the occurrence reports and although the specific circumstances of these reports did not lead these events to be categorised in the key risk areas they could in other circumstances or in combination with other events, contribute to an aircraft upset or collision with terrain or obstacles (e.g. critical equipment failures, aeronautical chart errors, birdstrike, laser attack).
The largest number of reports from this sector concern system component failures. Fortunately, most of these events were classified as low risk, meaning that the failures had a minimal impact on the safe operation of the aircraft (e.g. due to built-in system redundancy).
By its own nature, helicopter operations present a challenging environment for aircraft equipment and EASA, as the competent authority for aircraft design in Europe, has identified a number of mitigation actions to address the main safety issues arising from helicopter equipment failures in EPAS.
Section D deals with air navigation services and aerodromes. This section looks at flight hours, flight movements, accidents and serious incidents involving aircraft engaged in commercial air transport (CAT) at certified and licensed aerodromes in Ireland where an ATC service is available. There are a total of nine such aerodromes: Dublin, Cork, Shannon, Ireland West, Kerry, Donegal, Sligo, Waterford and Weston. The aircraft involved may be registered in Ireland or abroad and have an AOC issued by the IAA or a foreign NAA. Accidents and serious incidents involving aircraft engaged in general aviation (GA) are not included unless there

is a second aircraft involved in the same event that was providing commercial services.
The number of flight hours increased in 2019. This includes traffic flying over Irish airspace as well as aircraft landing at or departing from an Irish airport (terminal traffic). The number of flights describes the number of aircraft landing at and departing from an Irish aerodrome. The latter decreased slightly during 2019, despite the growth in the number of flight hours.
There were 4 incidents, none of which resulted in fatalities, and 15 serious incidents during the five year period under review.
In exactly the same way as outlined in the sections above, the IAA receives occurrence reports from ANS providers in relation to precursor events occurring in Irish airspace - including en-route operations, terminal operations and ground operations where ATC services are provided - and from aerodrome operators - primarily in relation to ground operations involving aircraft and ground vehicles or equipment. In both cases these reports are reported according to the subdivision into indexes and descriptive top-events.
As part of the EU Single European Sky ATM performance scheme for air navigation service provision, and in support of European-wide initiatives on safety data reporting including Eurocontrol's Annual Summary Template process, the IAA monitors national safety performance against five safety performance indicators (SPIs) which contribute largely to the main events reported to the IAA.
They are:

- Separation Minima Infringements (SMI)
- Runway Incursions (RI)
- Deviations from ATC Clearance (AD)
- Level Busts (LB)
- Airspace Infringements (AI)

The occurrence rates of these SPIs across all ANS providers in Ireland are shown in the figure below.

Standardised Rates (SMI, AD, LB, AI rates per 100,000 flight hours) (RI rate per 100,000 movements)					
Year	Separation Minima Infringement	Runway Incursion	Deviation from ATC Clearance	Level Bust	Airspace Infringement
2015	4.85	5.79	51.25	15.58	9.70
2016	3.22	5.90	58.88	17.37	8.69
2017	2.88	5.46	44.49	16.00	10.24
2018	2.54	2.66	50.45	17.77	10.15
2019	4.00	3.80	80.10	21.10	8.40
5 Year Average Rate	3.50	4.72	57.03	17.56	9.43

Figure 3.48: Irish ATM performance Monitoring Rates.

The last section deals with general aviation. In Ireland it is defined as any aviation activity not classified as Commercial Air Transport and includes aviation activities regulated by European law such as:

– non-commercial operations using complex aircraft (Part NCC);

– specialised operations (Part SPO) such as aerial photography and parachute support operations;

– non-commercial operations using non-complex aircraft (Part NCO) such as pilot training, introductory flights, private flying and cost-sharing flights.

In addition, it includes aviation activities subject to Irish national law such as private flying of ultralights, self-built aircraft and gyroplanes.
There is a diverse range of General Aviation activities in Ireland whose safety performance is examined in the last section of the Safety Review using the following categories of aircraft:

- Aeroplanes with a maximum take-off mass (MTOM) of 2,250 kg and above.
- Aeroplanes with an MTOM less than 2,250 kg.
- Homebuilts also referred to known as amateur-built aircraft or kit planes.
- Microlight aircraft – typically aeroplanes with MTOM less than 450 kg and flex-wing aircraft.
- Helicopters – with an MTOM of 2,250 kg and above.

- Helicopters – with an MTOM of less than 2,250 kg
- Gyrocopters.
- Sailplanes and powered sailplanes - with rigid wings and undercarriage.
- Paragliders, powered paragliders (paramotors) and powered parachutes.
- Hot Air Balloons.
- Specialised Operations e.g. parachute support operations, banner towing, and aerial photography.

Figure 3.49 provides a summary of the safety performance of this sector in respect of accidents and serious incidents. Accidents and serious incidents include all General Aviation accidents and serious incidents that occurred in Ireland, regardless of whether the aircraft was registered in Ireland or abroad (e.g. an aircraft registered abroad based in Ireland).

GA Sub-Sector	No. of fatal accidents (fatalities) 2019	Total no. of fatal accidents (total fatalities) 2015-2019	No. of non-fatal accidents 2019	Total no. of non-fatal accidents 2015-2019	No of Serious Incidents 2019	Total no. of serious incidents 2015-2019
Aeroplanes ≥ 2250 kg	0 (0)	2 (2)	1	1	0	0
Aeroplanes < 2250 kg	1 (2)	3 (4)	2	17	2	12
Home-built < 2250 kg	1(2)	2 (3)	2	5	1	1
Microlight aircraft	1 (1)	2 (2)	0	3	0	1
Helicopters > 2250 kg	0 (0)	0 (0)	0	0	0	0
Helicopters < 2250 kg	0 (0)	0 (0)	0	6	0	1
Gyrocopters	0 (0)	0 (0)	0	1	0	0
Sailplanes	0 (0)	0 (0)	1	3	1	1
Paragliders	1 (1)	2 (2)	1	1	0	1
Balloons	0 (0)	0 (0)	0	0	0	0
Specialised Operations	0 (0)	1 (2)	0	1	0	0

Figure 3.49: Safety performance summary of Irish General Aviation.

The report provides a breakdown in common taxonomy categories of the occurrences between 2015 and 2019 regarding aeroplanes with an MTOM below 2,250 kg and Fixed Wing Homebuilts with an MTOM below 2,250 kg. The cases of highest interest according to the data available in Figure 3.34 as they are those characterised by a major number of events within the five-year period under consideration.
Regulations on mandatory occurrence reporting include general aircraft pilots flying type certified aircraft. Many of the aircraft involved in this sector are not certified, however pilots of these aircraft can report occurrences on a voluntary basis using the same systems. The IAA website provides guidance on occurrence reporting requirements as well as the links needed to submit reports to the IAA.

The regulations include provisions concerning confidentiality, protection of reporters and the appropriate use of information contained in occurrences. Abnormal Runway Contact, Medical, System failure, Navigational errors and ATM were the top 5 categories identified in the submitted mandatory occurrence reports.
The level of occurrence reporting received from those involved in general aviation for leisure flying is very low and does not currently support adequate statistical analysis, meaning that the opportunity to learn from past experience is limited to accidents and serious incidents. The reporting culture, evident in commercial aviation, is more difficult to achieve in general aviation, even though many of the people involved in general aviation are also involved in commercial aviation. This lack of a good reporting culture means that the IAA is unable to report lower level events that could lead to accidents and serious incidents (in other circumstances) in this sector.
In summary, the Irish Safety Review appears to be well written and accurate. The data is optimally illustrated as well as the structure of the document, each aviation sector of interest has its own chapter and the topic is treated entirely within it: from the introduction to the topic to the final considerations and safety issues highlighted with possible mitigation actions, passing through a statistical analysis of accidents and serious incidents as well as SPI and lower level events.
The first level statistical analysis considers accidents and serious incidents, as seen above in the Finnish case, and not only fatal accidents. These are distributed according to the SPIs that most characterise that event, whereby there is a first subdivision according to the occurrences defined by ICAO Annex 13, [69]. Subsequently, all the occurrence reports received by the Irish national authority are considered, divided according to the SPIs of interest; no fixed number of indices is treated, but all those present are taken into consideration: from the most present case (SCF-NP with more than 5500 reports) to the rarest (F-POST, UIMC, USOS and LOLI with less than 10).
It is important to note that the data are illustrated in bar charts according to their risk level. Those at lower risk are shown in green, those at moderate risk in yellow and those at higher risk in red (ARMS Score 1-10, ARMS Score 20-102 and ARMS Score 500-2500 respectively). The Airline Risk Management Solutions (ARMS) is an aviation risk classification methodology developed by the EU that is used by the IAA to assign a risk score to each single event, within the document there is no explanatory definition of the relative score, only what the colours assigned to them represent.
An analysis according to lower-level events, called Top Events, follows that of the SPIs. They are represented in the same way as the previous ones, although there seems to be no European regulation regarding these. They are also represented according to the total number of occurrence reports received by the national authority.

It is evident that the IAA assigns greater importance to the CAT category as the country is host to one of the largest low-cost companies in the world and is one of the countries with the most registered aircraft worldwide, despite its small geographical size. This scenario requires an excellent safety oversight by the national authorities. Recent EU studies have shown that the occurrence reporting culture among Irish AOC holders is among the highest in Europe, a negative point however is the diffusion of the same within GA, clearly not at the level of commercial aviation, a point on which the IAA is continuously striving to improve.

3.5 Netherlands

The Dutch case is similar to the Finnish one because the local authority - Analysebureau Luchtvaartvoorvallen - has developed a virtual dashboard to create the Safety Review in a fully digital way.
Data on occurrences reported by Dutch civil aviation are collected and processed on a monthly basis and then illustrated via graphs and maps within the dashboard. Each page has the same structure that will be discussed later in this chapter. It is possible to navigate within the dashboard from the drop-down menu on the left of the screen where a first subdivision of events according to SPI indicators takes place.
The indicators analysed by the Dutch authorities are 13 in total and include the following:

- All incidents in the Netherlands
- Runway incursions
- Bird strikes
- Airspace infringements / airspace violations
- Loss of separation / loss of distance
- Unstabilised approach / unstable approach
- Dangerous goods
- Incidents with drones/RPAS
- Laser radiation
- Disruptive passengers
- Serious incidents and accidents

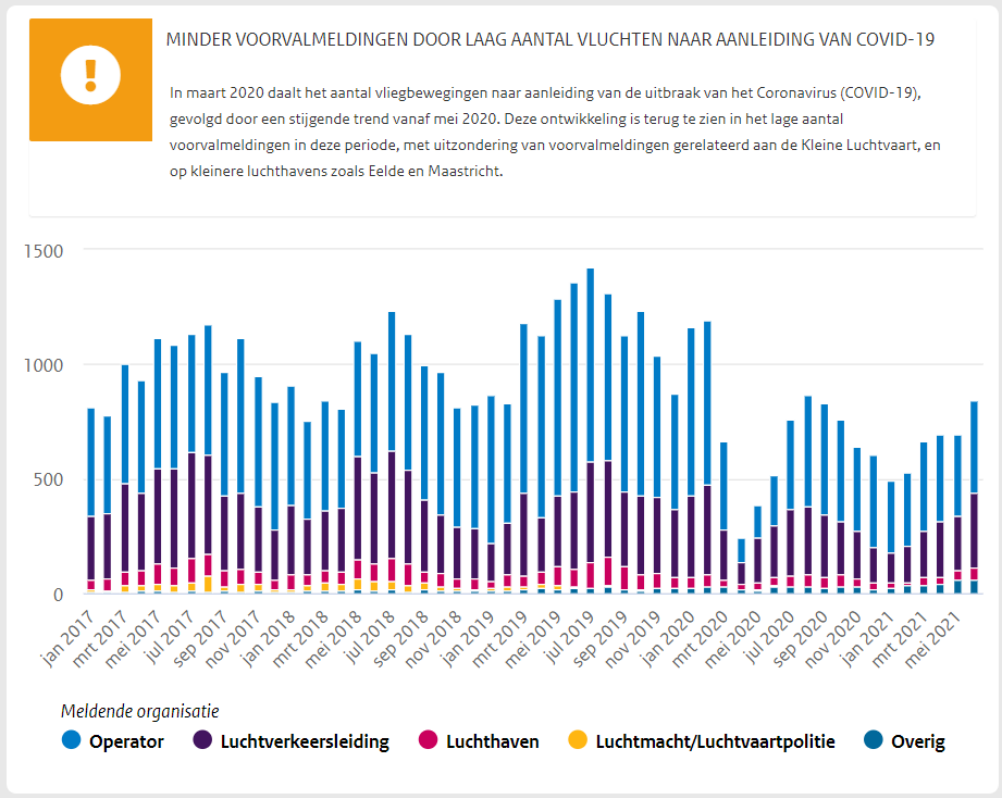

Figure 3.50: Main navigation menu of the Safety Dutch dashboard.

With regard to the first option, all reports of events in the Netherlands are taken into account, from fatal to less serious ones
The reports selected for this overview are those for which the ABL was able to conclude that the incident took place within Dutch airspace. The airlines and Dutch Air Traffic Control - Luchtverkeersleiding Nederland (LVNL) - are by far the most frequent reporters, followed by the airport authorities, the military aviation and a category defined as 'others'. These reports mainly concern events in large air traffic (Commercial Aviation, CA). A small proportion of the reports comes from GA. The CA can also report incidents in which the GA is involved, for example airspace violations. The GA can naturally also report on occurrences in the CA. The number of GA reports is low compared to the activity in this area.
An upward trend in the total number of reported events can be seen for the period 2017-2019. This is related to an increase in the number of flight movements. There is also a seasonal effect. This relates to peaks in the summer months. These peaks are also related to the relatively higher number of flight movements in summer.
In March 2020, the number of flight movements decreases due to the COVID-19 pandemic, followed by an increasing trend from May 2020 onwards.

This development is reflected in the low number of event reports in this period, with the exception of event reports related to small-scale aviation and smaller airports such as Eelde and Maastricht.
Within the same page there is a map of the country on which the respective locations for the received reports are placed. A greater concentration can be observed in the proximity of the most important national airports, the case of Amsterdam-Schiphol airport being the most evident.

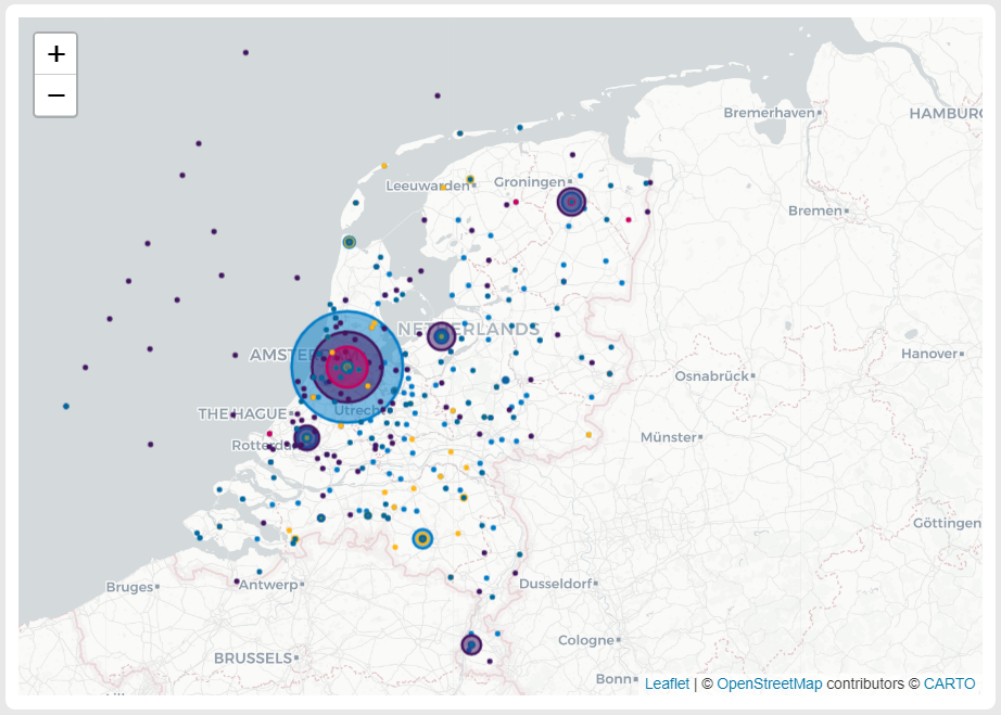

Figure 3.51: Breakdown of reports received by Dutch authorities within the Dutch airspace.

Positioned towards the right-hand side of the page there is also a window with which it is possible to apply a series of filters. First of all, it is possible to filter by sub-category, in which case reports can be viewed according to the organisation responsible (airlines, air traffic control, etc.), by type of aviation, dividing CA from GA or highlighting only those cases of interaction between the two, or filter by geographic location or airport.
In addition to the filters, there is a brief explanation and interpretation of the index under examination on that page and the possibility of viewing the data in table form and downloading it in .csv format.
This window and the respective filter possibilities are shown in the image below.

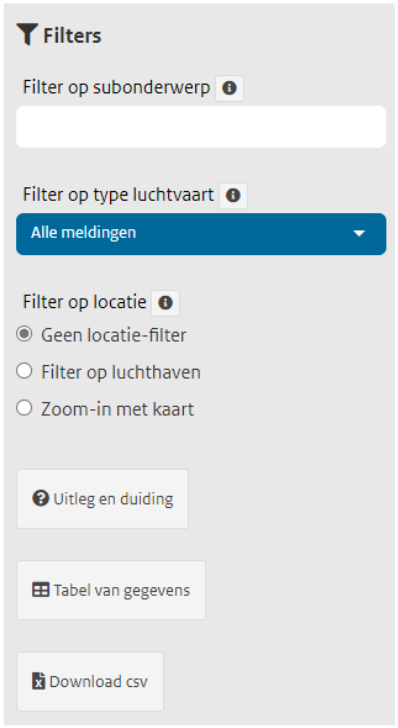

Figure 3.52: Window for applying filters to displayed data.

The second topic dealt with is Runway Incursions. A RI is an incident on a runway involving an aircraft, vehicle or person that should not be there at the moment. It can be seen from the image below that the average number of reported runway incursions decreased from 2017 until the first quarter of 2019, although from the second quarter onwards the trend was upwards until the peak in January 2020 (22 incidents). During the year of 2019 a total of 76 cases occurred, with June being the most affected month (10 cases) and January, July and September the least (only 4 cases).
Dutch Air Traffic Control and the Integral Safety Management System (ISMS) of Schiphol determine the severity of the accident using an internationally established severity classification:

- A - Serious incident where a collision has been narrowly avoided.
- B - Incident where the distance decreases and there is a significant risk of collision, possibly followed by corrective or evasive action to avoid a collision.
- C - An incident involving more than sufficient distance to avoid a collision.
- D - An incident where a vehicle, person or aircraft is unjustifiably present in

the restricted area designated for aircraft landing and take-off, without having an immediate effect on safety.

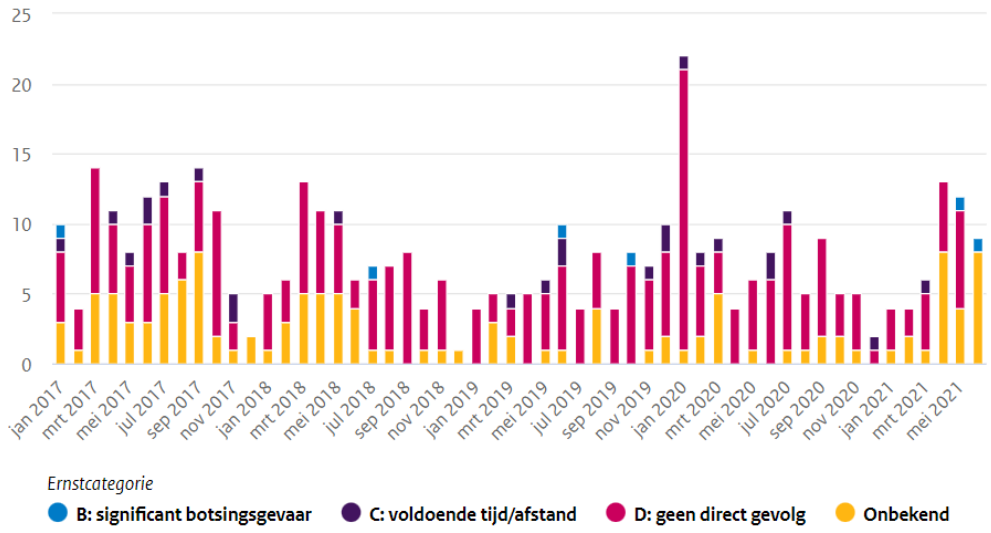

Figure 3.53: Distribution of RI-related occurrences within Dutch airspace from 2017 to mid-2021.

The third topic on the Dutch Safety Dashboard is the Birdstrike phenomenon. This phenomenon is particularly dangerous as it can result in accidental damage to an aircraft, e.g. a bird can crash into the cabin window of a small aircraft in the case of general aviation, or it can be eaten up by the engine of a liner aircraft. This makes Birdstrike a real risk to aviation safety.
Analysing the figure below (Figure 3.54), which shows the trend for this phenomenon from the first months of 2017 to the first half of 2021, a clear seasonal effect can be observed. The Birdstrike phenomenon becomes particularly evident towards the middle of the summer months (July-August), probably due to the beginning of lowering temperatures and the start of bird migration movements.
Not all reports of Birdstrikes are about actual bird impacts against an aircraft: sometimes the reporter is unsure whether a collision has actually occurred, while other reports are about bird remains found, or sometimes a report is a warning about the possible presence of birds within a certain route.
It can be seen that, compared to previous years, the total number of reports of Birdstrikes in the Netherlands increased in 2019, during the month of August there were more than 200 occurrences while during the whole year there were 1263 events. Looking at the data for 2020, it can be seen that in the summer months of 2020 the number of Birdstrike reports dropped dramatically compared to the previous

year. One explanation for this is the low number of flight movements due to the COVID-19 pandemic.

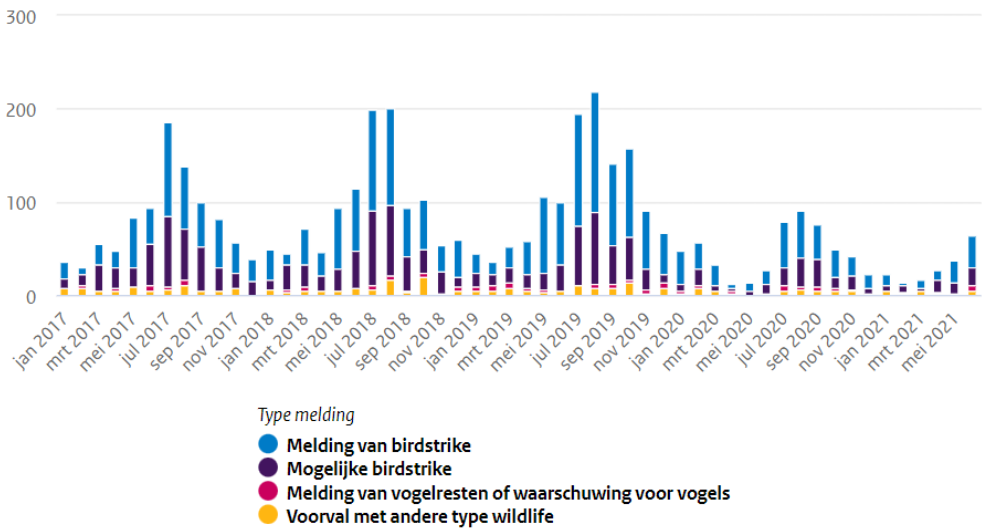

Figure 3.54: Distribution of Birdstrike-related occurrences within Dutch airspace from 2017 to mid-2021.

The topic that is dealt with in succession is the one concerning the phenomenon of Airspace Infringements. When an aircraft or drone enters a certain part of the airspace without permission, it is called an airspace infringement. In 2019, there are fewer reports of airspace infringements up to October than in the previous year. The peak occurring in November and December 2019 consists mainly of reports of airspace infringements in the air traffic area of Lelystad Airport. During that period, the airspace structure above that airport was adjusted. The airspace is now controlled by air traffic control and the approach procedures have been changed. These changes have led to an increase in reports. The Dutch authorities have already started investigations regarding the anomalous trend during those months and continue to monitor the measures taken at local level.
The events are categorised according to four different categories depending on the area where the infringement occurred, which are explained below. It can be seen in Figure 3.55 how the most predominant one since the beginning of 2019 is CTA, followed by TMA.

- CTA - Control Area: general airspace under the control of air traffic control from a certain height above the earth's surface and beyond.
- TMA - Terminal Control Area: controlled airspace in the approach area

around an airport.

- CTR - Control Zones: Local air traffic control zones from the surface of the earth to a certain height.
- RVSM - Reduced Vertical Separation Minima: airspace where the permitted vertical separation between aircraft is set from 2000 to 1000 feet.

During 2019, there were 306 occurrences of Airspace Infringements. September was the least affected month (11 cases), while the peak in November-December can be clearly identified (84 cases, almost 30% of the annual cases).

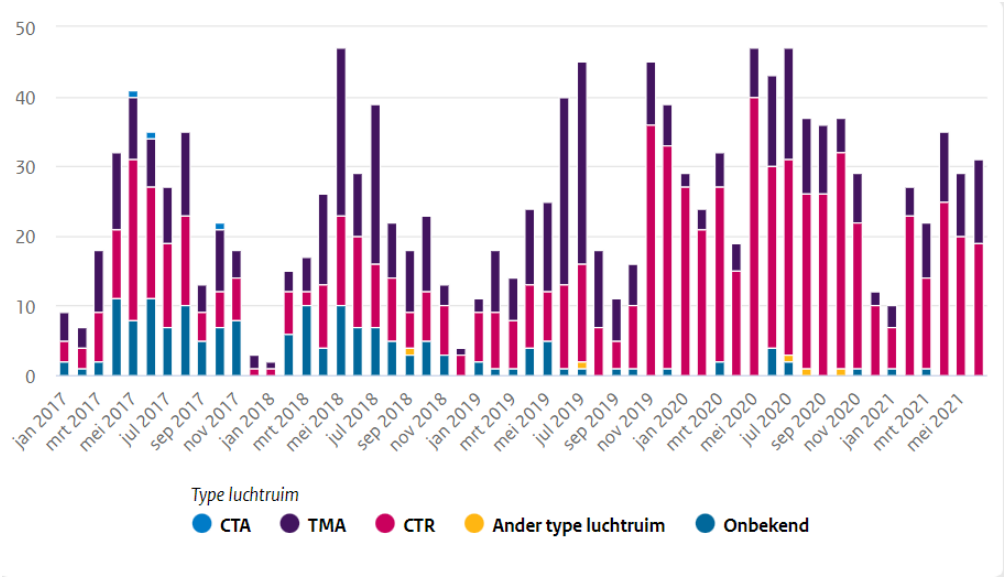

Figure 3.55: Distribution of Airspace Infringements-related occurrences within Dutch airspace from 2017 to mid-2021.

The following topic is Loss of Separation. The minimum distance between aircraft in flight is applied both horizontally and vertically in order to ensure the safety of the aircraft. When two aircraft get too close to each other, there is a loss of distance. The responsible Dutch authorities record these and report them to the ABL. Airlines and airports can also report when this distance is exceeded. The ABL does not consider the proximity of drones in this overview.
When the distance between the aircraft involved is known, then it is also possible to determine the degree of Loss of Separation and classify it (from A when it is less than 50% of the norm to D when it is more than 100%).
The data for 2019 shows a worse situation than in previous years, two different peaks can be observed: one during the summer months (June-July) when flight

movements are greater due to the season and an anomalous one during the month of November. In total, 170 cases of Loss of Separation were recorded during 2019 of which around 40% (71 events) occurred during June, July and November.
The abnormal peak in November is due to the many type A reports (undershoots) recorded in the airspace at Lelystad airport. On that date, the airspace structure above Lelystad was adjusted and modified as explained above.There is a similarity between the Loss of Separation and Airspace infringement indices, although in the latter case other means (i.e. airport ground means) are considered in addition to aircraft and the area in which the event occurred is considered as the division category, while in the former only aircraft-aircraft iteration and the severity of it is considered as classification category.

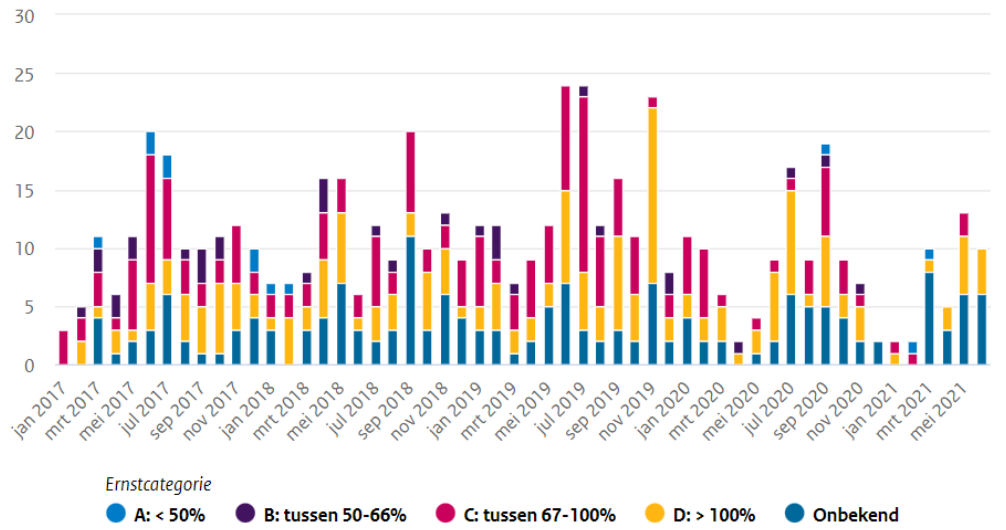

Figure 3.56: Distribution of LoS-related occurrences within Dutch airspace from 2017 to mid-2021.

The sixth criterion that is dealt with by the Dutch authorities is the Unstabilised Approach.
In order to be able to land safely, there are criteria on speed, configuration (flaps and landing gear retracted) and the aircraft's position on the glide path to the runway. An Unstabilised Approach occurs when the aircraft does not meet these criteria. Normally, the pilot does not continue the landing, but makes a go-around. In 2017, this covered 80% of Unstabilised Approach reports. In 2018, this dropped to 60%. Since then, an increase in the number of go-arounds can again be observed, although it has remained consistently below 2017 levels during both 2019 and 2020. If the aircraft lands, this can result in a hard landing, or landing in front, side or

behind the runway.
These are then the two categories by which the catalogued data are divided: Go-around, if the landing itself is aborted, or Landing if the aircraft completes the operation.
In 2019 there were a total of 121 cases, of which 79 (about 65%) were go-arounds.

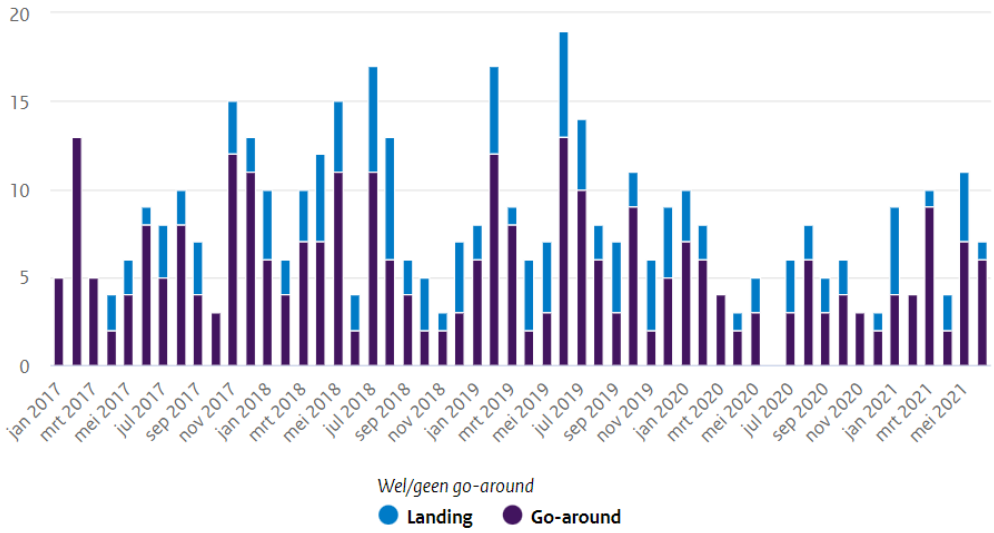

Figure 3.57: Distribution of Unstabilised Approach-related occurrences within Dutch airspace from 2017 to mid-2021.

Some goods may represent a threat to flight safety, for example because toxic substances may be released. For this reason, a ban or restrictions shall apply to the transport of these goods. In this case the term Dangerous Goods is used.
The ILT pays particular attention to the transport of lithium batteries. This is due to the risk of spontaneous combustion, so any deviation from the Dangerous Goods protocol is reported to the ABL as an aircraft accident. The topic of Dangerous Goods is the one dealt with immediately in succession.
Since 2018, Dangerous Goods reports have decreased significantly. During 2019, a total of 40 cases were reported. Divided according to the type of notification into: notifications for damaged lithium batteries, notifications for leaking substances or other.

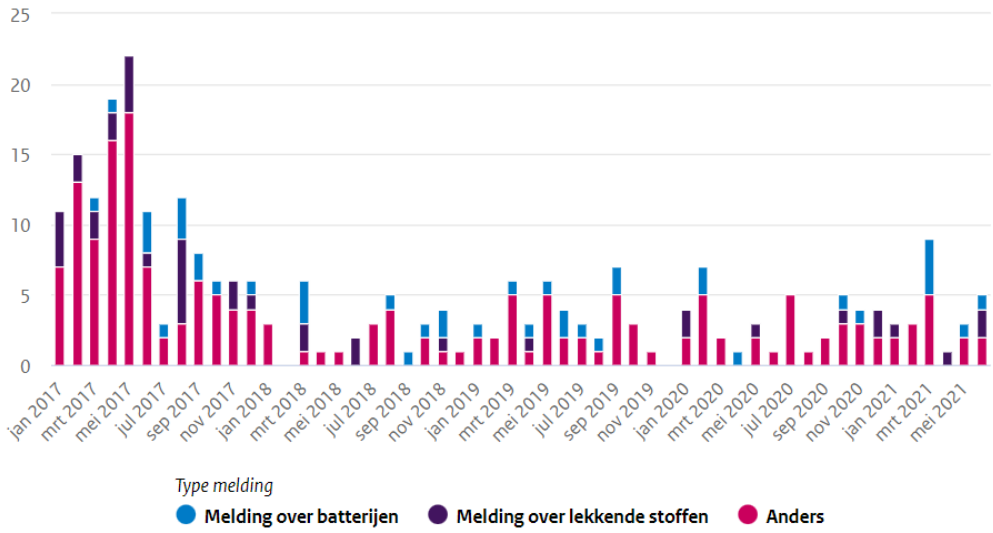

Figure 3.58: Distribution of Dangerous Goods-related occurrences within Dutch airspace from 2017 to mid-2021.

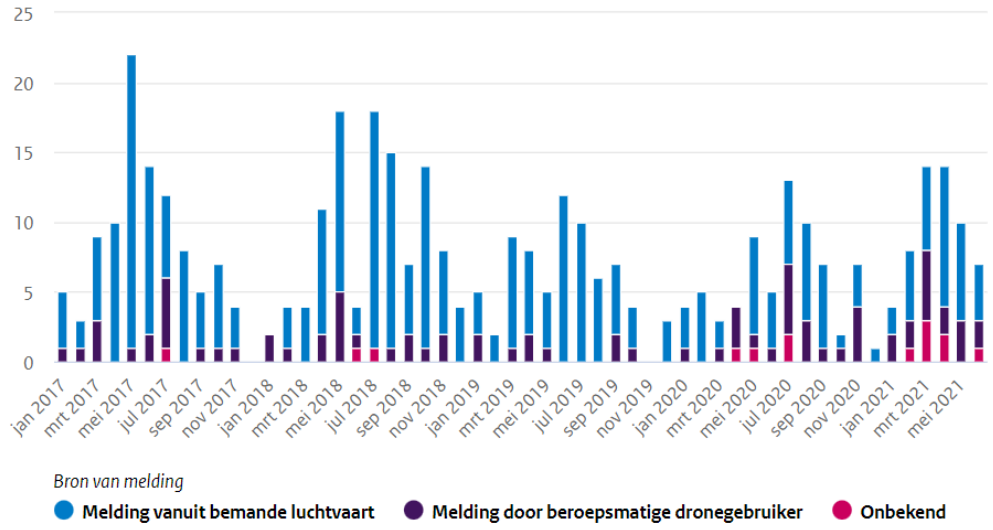

Figure 3.59: Distribution of Incidents with drones related occurrences within Dutch airspace from 2017 to mid-2021.

The ABL receives reports from the manned aviation about (presumably recreational) drones. It also receives reports from professional drone users. This second category of reports can also be about airspace violations by manned aviation when airspace is reserved for drone use.

Drone incidents show a clear seasonal effect. In 2019, the ABL received fewer reports on drones than in 2018. During the same year, the ABL/ILT published a report on the risks of drones to manned aviation.
A total of 71 cases occurred during the year of 2019, with an evident peak during the summer season (June-July) where movements are more intense.

Another phenomenon of importance according to the Dutch authorities, which finds a special page within the Safety Dashboard, is the phenomenon of Laser Radiation. Pilots can be illuminated by lasers from the ground. This can have a very annoying blinding effect. Laser radiation can constitute a safety risk, partly because it can cause a frightening reaction or a blinding effect. The number of reported laser radiation attacks has shown a downward trend in recent years.
The number of reports is divided into two main categories: those occurring during the landing/take-off phase or during flight.
During the year of 2019, 116 occurrences took place, of which 34 were during the landing/takeoff phases and 82 during flight. The data are illustrated in the image below.

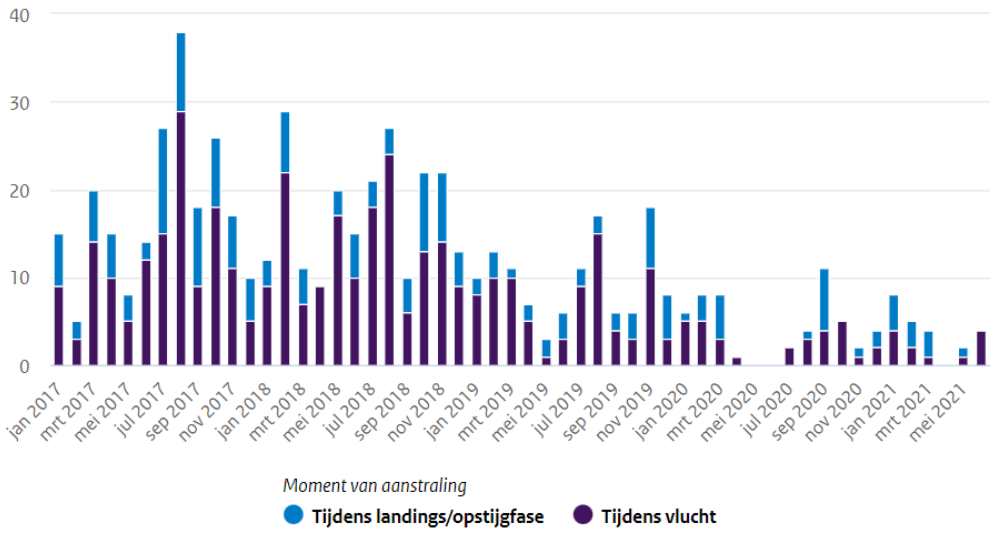

Figure 3.60: Distribution of Laser Radiation-related occurrences within Dutch airspace from 2017 to mid-2021.

The last topic dealt with goes back to a subject that is often ignored by authorities in other countries, Passenger Misbehaviour. This can hinder the cabin crew in their work, causing unsafe reactions that could lead to worse consequences. In exceptional cases, the aircraft may be forced to return to the airport of departure.

Recently, EASA launched a campaign to bring attention to this problem. Reports collected by the Dutch authorities show an increase in the relative number of serious incidents involving aggressions. The ABL/ILT has published a report sheet about disruptive passengers during 2019. The data in the bar chart also includes events that take place outside Dutch airspace (but on flights of Dutch airlines).
In 2019, there were a total of 1107 events. At the start of the COVID-19 pandemic, there was a marked decline in the number of disorderly passenger reports. This is related to the low number of flights in March, April and May 2020. From June 2020, an increase in COVID-19 related reports can be seen, for example of incidents where passengers do not comply with prescribed safety measures.
Since June 2020, when the aviation sector was showing the first signs of recovery, the ABL has received reports about passengers who do not comply with the corona measures, such as wearing a face mask. From July 2020, a clear increase in such reports is visible.
The ILT published a report on 10 August 2020 to draw attention to the increase in these reports.

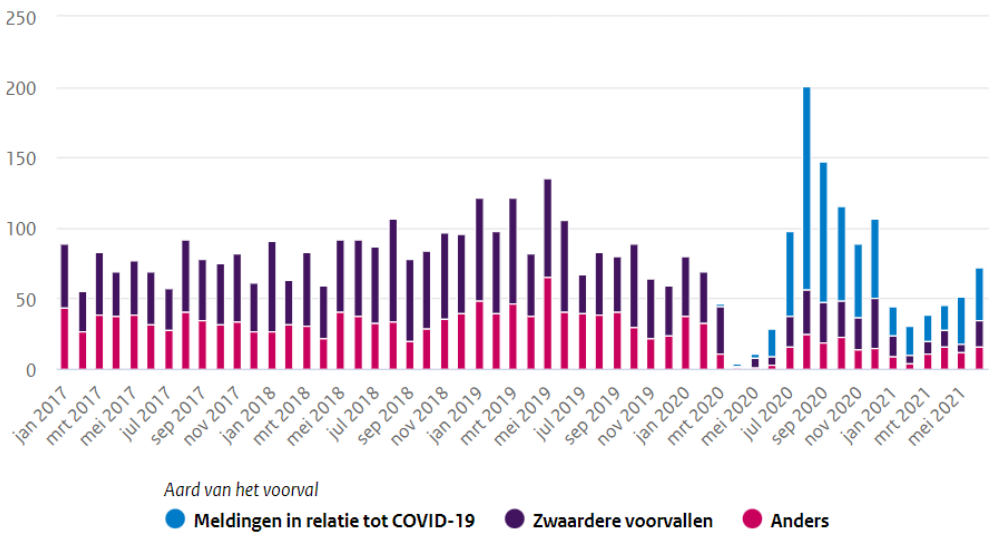

Figure 3.61: Distribution of Passenger Misbehaviour-related occurrences within Dutch airspace from 2017 to mid-2021.

Chapter 4

Comparative analysis

Once the in-depth analysis carried out on the safety reports of the countries specifically selected in the previous chapter has been completed, the main topics of interest can be outlined in order to compare the structure of the different documents and their data. The topics identified are:

- the language used to write the document;
- the indices of the first statistical analysis, the main one, also called Main Indicators or Tyer-1 Index;
- how the main indices are measured;
- the type of indices used for further statistical analysis, if available, also known as Secondary Indicators;
- how the secondary indicators are measured;
- which are the most relevant secondary indicators;
- if relevant indicators from other analysed countries are present in the document.

After illustrating the data for the topics of the cases considered in the previous chapter, it is possible to hypothesise a sort of first template with the minimum demands which the authorities of the different states might be subject.
Naturally, these would be minimum demands, since the cultural and economic diversity within the Member States of the European Union and EASA has a wide spectrum. Each country is free to compose its own document by adding all the elements it considers necessary or of interest, but respecting an identified minimum requirement.

The minimum prerequisites are not far from the aims presented by EASA and the European Union in Regulation 376/2014, [3]. Fulfilling them would allow a greater and more efficient control by the agency as well as an easier distribution and comparison of data between countries. It will also make more easier for less experienced users to find and read these documents.

The first topic of discussion is the language the report should be written in. Currently, many countries publish their Safety Review in their own language, which does not make it easy for users from other states to access it. EASA does not require its Member States to publish documents or articles in a specific language, all European are accepted. However, the use of a language that is widely known would be preferable in order to facilitate a greater accessibility and exchange of information between countries: although the United Kingdom is no longer part of Europe, English could be a valid alternative.

	Finland	France	Italy	Ireland	Netherlands
Language	*Finnish and English*	*French*	*English*	*English*	*Dutch*

Table 4.1: Safety Review language

After the introductory phase of their document, most of the countries examined carry out an analysis of accidents and incidents within a given time period. This reference time span can be longer or shorter, some countries choose longer and not fixed periods (e.g. Norway, which has been studying accidents since 1946 with a moving mean every 5 years) while others decide to set a fixed reference span (e.g. Italy and the Netherlands, respectively five and three years).
Generally even the subject of such study can vary from one country to another, some consider only accidents, others include serious accidents as well, and some also include the respective fatalities.
The presence of this analysis is common to all the documents reviewed, whether in depth as done in the third chapter or briefly in the second, the only difference is the way it is done. Given the common presence, it can be assumed that all countries regularly collect data on such events, so they should have no problem in complying with a common request.
The ultimate aim of such analysis is not just to expose their own data, but to interpret it. Therefore, it is important to have a minimum range of data available in order to be able to identify and study a trend. For this reason, a minimum study of the number of both accidents and serious incidents over the last 10 years is an accurately feasible hypothesis that could result in an effective outcome.

	Main Indicators	Time Period Considered
Finland	*Serious incidents, accidents and fatalities*	*15 years*
France	*Accidents*	*32 years*
Italy	*Accidents*	*12 years*
Ireland	*Serious incidents and accidents*	*5 years*
Netherlands	*Serious incidents and accidents*	*3 years*

Table 4.2: Safety Review main indicators and time period considered

Identified which event and how much it should be measured, it is also important to highlight the unit of measurement which should be used. Accidents and serious incidents are rare events nowadays, so it would not make sense to normalise their unit of measurement according to the number of flights or movements. Based on the Safety Reviews analysed, the most accurate choice is to report the total number of occurrences, as most countries currently do. However, each country is also free to consider normalised indices, although in its own report they offer a way of easy comparison with other countries, as defined above.

	Main Indicators measurement type
Finland	*Number of occurrences , per 10 000 or 100 000 flight hours*
France	*Number of occurrences*
Italy	*Per million departures*
Ireland	*Number of occurrences*
Netherlands	*Number of occurrences*

Table 4.3: Safety Review main indicators measurement type

A second statistical analysis is not always present in the Safety Reviews studied so far, but when it is, it is clear which indicators should be used. European legislation is clear on this point, the so-called Secondary Indicators are the SPIs. These indicators are present in the reports of all the countries analysed in the previous chapter.
The real problem is the unit of measurement used for these indicators, a point which is not addressed by European legislation, which leaves the various states completely free to decide.
Defining a unit of measurement for SPIs is unfortunately not easy. Setting up SPIs could prove to be a very costly activity, and it is necessary to have a deep knowledge of a country's safety culture in order to better characterise them.

	Secondary Indicators
Finland	*SPI*
France	*SPI*
Italy	*SPI*
Ireland	*SPI*
Netherlands	*SPI*

Table 4.4: Safety Review secondary indicators

On the other hand, it is also necessary to find a common unit of measurement that is suitable for all countries, in this way the indices can be easily compared from one situation to another, in order to offer a safety scenario that is as clear as possible at European level. From the table below it can be seen that this is currently not feasible. The five countries, whose reports were analysed in detail above, used four different ways to illustrate their indicators. The most appropriate strategy is to choose a standardisation criterion that can be adapted to all the different situations in Europe. But it is important to note that the number of movements in a small country is not comparable at all to that of a large one, and the same can be said for the number of flights. Choosing a criterion is not a simple task and can not be done a priori in this study, but a homogeneous decision within the European scenario is urgently needed. A temporary solution could be to adopt a normalisation by number of movements within one's own airspace, until a definitive and more appropriate alternative is found.

	Secondary Indicator measurement type
Finland	*Number of occurrences*
France	*Percentage of events total number*
Italy	*Number of occurrences and per 10.000 movements (or flights)*
Ireland	*Number of occurrences*
Netherlands	*Number of occurrences per month*

Table 4.5: Safety Review secondary indicator measurement type

It might be considered not to normalise these indicators, leaving only the total number of occurrences expressed, but this could result in conflicting information. For example, from one year to the next, a slight increase in the number of occurrences for a certain index could be observed. This would suggest a deterioration of the country's safety situation, but it could be justified by a significant increase in flights or movements within that state. By not expressing this index as a rate but as an absolute value, this information would be lost.

The last important topic for the creation of a template is which and how many SPIs should be analysed. From the table below it can be seen that there are very few prevailing SPIs in common between the countries considered in the fourth chapter analysis. In particular, each country has a different safety culture and operating scenario, and there are huge differences within Europe, such as the Mediterranean countries compared to the Scandinavian or Balkan ones. Therefore, it is pointless to list a series of indices decided a priori without considering the background of the individual state. Instead, it is more useful to define a minimum number of indexes that must be taken into account in order to adequately describe the current national safety situation. From the safety reviews analysed, it can be deduced that a number of indices between 8 and 10 is sufficient to fulfil this task.

	Most relevant Secondary Indicators
Finland	*MAC/Airpox, RI, LASER*
France	*LOC-I, UNK, F-POST*
Italy	*UPA, LASER, SMI*
Ireland	*SCF-NP, RAMP, MAC/Airprox*
Netherlands	*Birdstrike, Passenger Misbehaviour and Airspace Infringements*

Table 4.6: Safety Review most relevant secondary indicators

The resulting template can therefore be summarised in the following table.

	Template
Language	*English*
Main Indicator	*Serious incidents and accidents*
Time Period Considered	*5 years*
Main Indicators measurement type	*Number of occurrence*
Secondary Indicators	*SPI*
Secondary Indicator measurement type	*Rate per 10.000 movements*
Number of Secondary Indicators	*8 - 10*

Table 4.7: Possible template for a Safety Review

Differences across the European panorama are significant: some countries are already able to develop online portals where they can present their own data in a clear and dynamic way, while others still struggle to publish their documents in accordance with the deadlines.
EASA's role is to provide its Member States with clear and precise instructions, allowing those with fewer resources to fulfill their obligations. The ideas proposed for a template earlier in this chapter address the key point that a Safety Review should have in order both to meet regulatory requirements and to provide a tool for states to continuously monitor their safety status. This allows a continuous monitoring of the operational scenario across the continent through the constant exchange of information, which is one of the main objectives of the Safety Review publication.

Chapter 5

Conclusions

In this thesis we reviewed and analysed the European regulatory framework on safety in aviation. The published documentation proved to be extensive, complex and diverse. We found that there are no substantial obstacles to the application of laws and regulations, both at international and European level, even considering their different scopes and objectives.
According to Regulation (EU) No 376/2014, [3], every year each Member State must publish a comprehensive annual safety report. However, this requirement is not entirely fulfilled by each European country: we noted significant differences among the countries that we have studied, both in the frequency of the publication of the safety reports and in the presented data. The lack of standard guidelines, and the wide economic and cultural differences among the studied countries are the key issues to be taken into account in our work.
After defining the state of the art of the publication of Safety Reports, we decided to compare documents of different countries in order to draw attention to some elements that can pave the way to a general template for the Safety Report.
We selected some noteworthy elements necessary to a first draft template from a deep and wide ranging comparative analysis of the Annual Safety Reviews published in 2019.
In order to allow an efficient control by the European agency on the quality of safety reports, each Member state should satisfy a set of minimum requirements. This would also facilitate data distribution and comparison between different countries, and the readability of the safety reports by non-specialists.

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